THE ROMANCE OF MODERN EXPLORATION AND DISCOVERY

NORMAN MACMILLAN

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THE ROMANCE OF MODERN EXPLORATION AND DISCOVERY

by

NORMAN MACMILLAN

M.C., A.F.C., A.F.R.Ae.S.

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INTRODUCTION

THOUSANDS of years ago the known boundaries of the world were restricted. They fell into certain distinct areas, widely separated from each other. The people who lived in each area knew only their own portion of the earth.

Gradually their philosophers evolved learning: in some centres more rapidly than in others. Their wise men made a study of the heavens, the sun, moon and stars. The tribes knew the seasons, the winds and the rain: existence depended upon their local success in raising crops and in hunting. They learned to spin yarn, to make cloth, cotton and silk: to shape vessels in pottery and sometimes in metal: to build houses in stone, brick and wood in addition to mud and tent dwellings.

But for a long time human advance was slow. Well into the nineteenth century speed of travel was still measured by the speed of the horse on land, by the wayward winds at sea. Then a wider and swifter civilisation arose with the discovery of the steam engine. Power applied to ships threw the sea route open to time schedules. Steam locomotives produced fast and regular inland travel.

The twentieth century began with less to be discovered and explored. The major part of the world was mapped and reasonably well known. The motor-car was evolving, electricity in use, wireless already discovered. But the aeroplane had not been invented. Medical science was still relatively crude. Despite many attempts, neither Pole had been reached. Enough remained for the adventurous to embark upon, to build a rich story of the romance of modern exploration and discovery.

NORMAN MACMILLAN

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Captain Scott about to set out on Skis.

CHAPTER I

CAPTAIN SCOTT GIVES HIS LIFE TO ANTARCTICA

IN the character of some men there is a rich flow that must find outlet in adventure. To such men ordinary life is like a prison until some way of release is found. Often the way of escape is an avenue that opens suddenly when least expected.

While spending a short leave in London, Robert Falcon Scott—a naval officer, thirty-one years old—heard there was to be an Antarctic Expedition. Two days later he applied to command it. In June, 1900, his appointment was announced, and Scott was promoted to the rank of Commander. The building of the ship *Discovery* was then three months under way.

Just think what it meant to Scott. He had spent eighteen years in the Navy. He was a sailor. He had no experience of travelling over snow and ice, nor of climbing or ski-ing. But none of these things deterred him. His heart was set upon adventure.

The *Discovery* sailed from New Zealand on Christmas Eve, 1901, and reached the Ross Sea on January 7, 1902. A landing was made at Cape Adare, and at several places on the coast of Victoria Land. Beyond the extreme end of the Ross Ice Barrier they discovered King Edward VII Land, but were unable to reach the shore. The *Discovery* then returned to McMurdo Sound and anchored beside Hut Point. The ship was frozen in by ice and used as a base throughout the winter.

On November 2, 1902, Scott, Dr. Wilson and E. H. Shackle-

ton set out on their first Southern venture. The dogs that drew the sledges died one after another, and the three men pulled in harness. On December 21, Dr. Wilson told Scott that Shackleton showed signs of scurvy, and on December 30 they turned back. By the middle of January Shackleton was seriously ill. All three were weak through insufficient food, but, by putting their sick comrade on the sledge when he was unable to walk, Scott and Wilson got Shackleton back to the ship alive on February 3, 1903. They had penetrated 400 miles into the unknown South, and covered 960 miles in 94 days: more than 10 miles every day, pulling a heavy sledge over a dreary wilderness of ice and snow. Scott and Wilson, too, were ill with scurvy and utterly exhausted by their tremendous effort.

The long winter passed. As soon as spring came, sledging was resumed. A party climbed Ferrar Glacier to the ice-cap. Although it was the beginning of the Antarctic summer, they found temperatures of 40 degrees of frost. The supporting party went no further, but Scott, with two seamen, Evans and Lashly, continued westward over a flat plateau which we now know extends beyond the South Pole. They pulled their sledge over the wastes of snow for 200 miles, then turned homewards, and got back safely.

The expedition sledged about 3,000 miles. Excellent scientific work was done in every branch. The most important discovery made was that of the great ice plateau which lies about 10,000 feet above the level of the sea.

When the *Discovery* expedition was completed, Scott returned to duty as a naval officer with the rank of Captain. He spent the next four years in command of battleships and in confidential work at the Admiralty, but always he longed to return to the wild South to complete his work.

When he launched his second venture, Scott was more than the Commander. He had to find the money. He begged for

The *Discovery* frozen in at Hut Point.

every penny needed while he organized each department of his expedition. He was particularly interested in the scientific side of Antarctic exploration. Dr. Wilson, his former sledging companion, took charge of the scientific staff. Instead of the two biologists of the *Discovery* there were four; instead of one geologist there were three; instead of one physicist there were two.

The undertaking which fired the imagination of the public, however, was the attempt to reach the South Pole. His need for money forced Scott to place that object in front of his scientific programme.

In September, 1909, he bought the *Terra Nova*, 744 tons, largest of the Dundee whalers. She was refitted in the West India Docks, London, and the expedition left England in June, 1910. A dramatic telegram was awaiting Scott when his ship reached Melbourne on October 12:

"Madeira: Am going South. Amundsen."

This message meant that Scott's expedition was in competition with Captain Roald Amundsen, one of the most famous explorers of the time. In 1905 Amundsen achieved the ambition of centuries by passing through the North-West Passage, and he had been in the Antarctic before Scott. Amundsen was Norwegian. It was a race between Great Britain and Norway to reach the South Pole first.

With this thought in the minds of all the ship's company, the *Terra Nova* left civilization on November 29. Two days later she almost sank in a gale. Surviving that, she entered the pack-ice on December 9. They sighted Cape Crozier on January 3, 1911, where Wilson was anxious to establish a base because it was nearer the Pole. But no suitable beach could be found. A site was chosen on Cape Evans, 18 miles north of Scott's former quarters at Hut Point.

The expedition began to disembark immediately. In a week timber and stores were all on shore. In a fortnight a hut was built. In three weeks they were ready to begin sledging.

Scott's attempt to reach the South Pole was not favoured by good fortune. In March they lost pony transport. This slowed the transport of supplies and reduced the quantity they could carry to the depôts. It also delayed the start of the great adventure.

On November 3, 1911, Scott's main party left Hut Point. They reached Corner Camp two days later and One Ton Depôt ten days after that. Their average speed was about 14 miles a day. They pushed on. But their speed was retarded by soft snow and a long gale of wind. More than six weeks later Scott wrote in his Journal:

> "December 29, 1911: Height 9,050 feet about. The worst surface we have struck, very heavy pulling. . . . It will be a strain to keep up distance. . . ."

Scott, Simpson, Bowers, and Evans, setting out for the West, drawing their heavily-laden Sledge. The wheel behind the sledge is for measuring the distance travelled.

When 168 miles from the Pole, Scott's advance team of five went on alone. The first day, January 5, 1912, was dreadfully tiring. Next day was no better. Evans cut his hand—an accident that might become serious, for in the Antarctic even small troubles may lead to disaster.

Hard pulling succeeded all the way. On the 16th they marched nearly 9 miles before lunch. They were just under 21 miles from the Pole. They started off again in high spirits, confident of reaching their goal next day. Suddenly Bowers saw a black speck upon the whiteness of the ice. It was the flag planted at the Pole by Amundsen on December 14, 1911. " All the day-dreams must go," wrote Scott.

On January 17 the five disappointed men marched on

another 9 miles and took observations. " This is an awful place and terrible enough for us to have laboured to it without the reward of priority. . . . Now for the run home and a desperate struggle," wrote Scott.

During their return their lives were dependent upon the food in the depôts. They missed none on their route. But for the first week they averaged only 13 miles a day. On January 24 a blizzard prevented them from travelling more than half their usual distance.

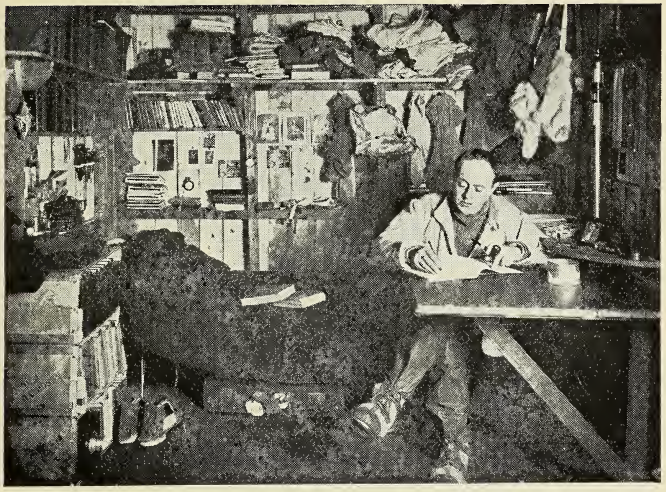
Scott wrote: " Things begin to look a little serious." Before the end of January Scott and Bowers were the only men free of ailments. Petty Officer Edgar Evans was the first to go. In frightfully rough ice he received a concussion of the brain. His incapacity threw an extra strain on the four others, and when he died he left them a shaken party.

They struggled on for 300 miles. The season was far advanced. On March 2, Scott wrote:

> " We are in a very queer street, since there is no doubt we cannot do the extra marches, and feel the cold horribly."

Even with the heavy work of pulling, they were cold. On March 4 the situation became hopeless, though not one of the party betrayed he knew it. On March 6 Oates was unable to pull. His feet were frostbitten; but he never complained of the pain. The next day was " a little worse. We are only kept going by good food," Scott wrote. They had not to bear the torture of continual hunger. " Worse and worse," was the first remark in the diary for March 8. That night, while the others were asleep, Captain L. E. G. Oates walked out into the blizzard. He sacrificed his last chance of life rather than delay his comrades further in their effort to reach safety.

The three survivors marched doggedly on for four days, and camped 13 miles from their next depôt. A blizzard



Captain Scott in the Hut, writing his Journal.

descended on them. They could not move while it continued. There was a temperature of 67 degrees of frost. They were all deadly cold. They had food for two days. The blizzard lasted nine.

Shortly before they perished, with the wind howling round them and the driving snow shutting out their vision, Scott, with Dr. Wilson and Lieutenant Bowers beside him, wrote in his last *Message to the Public:*

> " For 4 days we have been unable to leave the tent—the gale howling about us. We are weak, writing is difficult, but for my own sake I do not regret this journey, which has shown that Englishmen can endure hardships, help one another and meet death with as great a fortitude as ever in the past. We took risks, we knew we took them; things have come out against us, and therefore we have no cause for complaint, but

bow to the will of Providence, determined still to do our best to the last. But if we have been willing to give our lives to this enterprise, which is for the honour of our country, I appeal to our countrymen to see that those who depend on us are properly cared for.

"Had we lived, I should have had a tale to tell of the hardihood, endurance and courage of my companions which would have stirred the heart of every Englishman. These rough notes with our dead bodies must tell the tale, but surely, surely, a great rich country like ours will see that those who are dependent on us are properly provided for.

"R. Scott."

QUESTIONS

1. Name the new land that Scott discovered on his first expedition.
2. What was the most important discovery made by Scott on his first expedition?
3. Scott planned his second expedition for scientific exploration. He was more interested in that than in pure adventure. What was the factor that drove him to the discovery of the South Pole as the main quest of his expedition? Who reached the South Pole first?
4. What was the natural circumstance that cost Scott and his two surviving companions their lives although they camped only 13 miles from their next depôt and had food for two days?

CHAPTER 2

THE DISCOVERY OF THE NORTH POLE

DR. F. NANSEN, a Dane, first planned to explore the east coast of Greenland. A year later, in 1883, he decided to attempt to cross Greenland on skis from one coast to the other. For four years he was unable to make actual preparations for his venture. But in 1888 he made a successful journey across the ice-cap near the south of Greenland. Five years later he set out on a North Polar voyage.

Explorers usually try to avoid having their ships closed in by ice. Nansen deliberately set out to do this. His intention was inspired by a curious happening to a ship called the *Jeannette*, which was wrecked near the De Long Islands off the coast of Siberia in June, 1881.

In 1884 some wreckage drifted ashore near Julianehaab, on the south-west corner of Greenland. From an examination of the wreckage it was believed to be the remains of the *Jeannette*.

The wreckage had drifted from one side of the Arctic Ocean to the other. During its three years' journey it must have passed very close to the North Pole.

At that time no one knew if there was land at the North Pole. But the drift of the wreckage of the *Jeannette* showed two things. First, that there was open sea, ice-covered, all the way from the De Long Islands to Greenland. And second, that the ice moved across that sea in the direction the wreckage took. Following this theory, Nansen thought that

if he froze a ship in the ice off the Siberian coast it would drift, ice-bound, in the direction of the Pole.

He built a special ship for his purpose and christened it the *Fram*. With Sverdrup as navigator, he sailed through the Kara Sea to the Nordenskiöld Sea.

Ice enclosed the *Fram* west-north-west of the De Long Islands on September 25, 1893. Then began an extraordinary journey which has never been equalled in the story of Polar exploration. For nearly three years, unable to steer or sail, the *Fram* moved over the Arctic Ocean with the ice. She took a zig-zag course to the west-north-west until she reached a point 280 miles from the North Pole.

No land rose out of the desolate wilderness of ice and snow. The crew of the ship saw only a few Arctic birds and an occasional animal during their monotonous journey. Most of the time the ice-pack was unbroken, but sometimes there were violent movements of the ice.

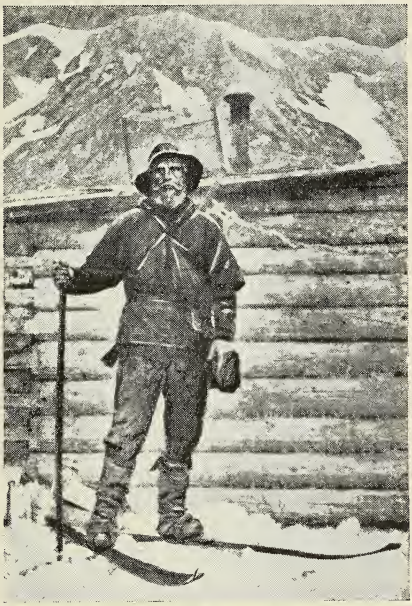
When the ice moved violently under the impulse of wind, ridges were thrown up to a height of 50 and 60 feet. In January, 1895, this crushing of the ice nearly destroyed the *Fram*. One can imagine the anxiety of the men on board while the ice cracked and groaned round the ship during the darkness of the Arctic night.

After the *Fram* reached her most northerly point she began to drift south-south-west. She remained almost stationary for five months, 404 miles from the Pole. She began to move again in June, 1896, and by skilful ice-navigation Sverdrup brought her into the open sea on August 13, 1896.

From the map at the beginning of the book you will see that the *Fram* started this remarkable journey west of the place where the *Jeannette* was wrecked. Her course was almost parallel with the drift of the *Jeannette's* wreckage. This meant that she could not reach the Pole during her drift. Nansen

realized this while the ship was still drifting to the north-west. He decided to attempt to reach the Pole on foot.

With Johansen as a companion, he left the ship with three sledges, 28 dogs and two *kayaks* (Eskimo canoes). They had provisions for a hundred days and the dogs for thirty days. Nansen calculated that they would reach the Pole, 410 miles away, in fifty days. The two men undertook this journey fully aware of the peril involved. The ice conditions they encountered were so bad that in twenty-three days they covered only 147 miles. With the Pole 263 miles distant, Nansen decided to turn south, knowing that he could not reach the Pole and get back safely.



Nansen photographed by Jackson, immediately after their first meeting on the Ice.

When they turned back on April 7, 1895, they were faced with the possibility of a five months' march to reach land. It was impossible for them to attempt to return to the ship, for she was moving with the ice and her position would not be the same as when they left her. In those days there was no wireless to help them to keep in touch, nor was there any

other means for them to know where the ship would be found.

Gales, fogs, and channels opening in the ice made travelling terribly slow. For two days Nansen was crippled by rheumatism; if this had continued, the delay would have cost their lives. Johansen was knocked down by a polar bear. Food became scarce. They had to kill the weakest dogs to feed the others until only two dogs remained alive. Food was almost exhausted when Johansen shot a seal.

Their watches stopped. This made it difficult for them to determine exactly where they were in the unchanging horizons of the ice-field. They pressed on. Finally they sighted Eva Island, and by the use of sledge and *kayak* turn about they reached Franz Josef Land on August 18, 1895.

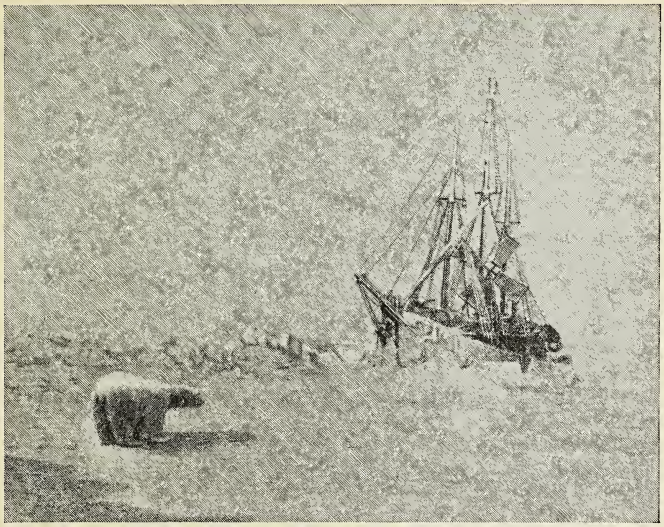
Nansen had intended to make Spitzbergen; conditions made that impossible, so they selected a suitable place where they were and built a stone hut to live in during the coming winter. Polar bears provided them with food; and, when they gathered round their hut in large numbers, with excitement.

After the long winter they headed for Spitzbergen on May 19, 1896. They had a terrible journey. Nansen fell into the sea through a soft ice floe and was nearly drowned. Once their *kayak* drifted away; Nansen dived into the icy water, swam after it and got it back. Two days later their meat ran out and a walrus damaged the *kayak*.

Their chances of surviving were almost gone, when on June 17 they encountered another explorer, Jackson, in the neighbourhood of Cape Flora, Alexandra Land.

Although he failed to reach the North Pole, Nansen made a world record which became known as Nansen's Furthest North.

Nansen's record was soon passed by an Italian explorer, Cagni, who sailed with the expedition of Prince Luigi Amadeo, Duke of the Abruzzi, in the *Stella Polare* in 1900. The ship



The *Fram* in the Ice.
(From a drawing by Nansen.)

anchored in Teplitz Bay, and Cagni left there on March 11, 1901, with 12 sledges, 10 men and 98 dogs. Two supporting parties were included in this team.

The first support party, with Querini and two seamen, turned back towards the ship on March 23. They were never seen again. The second support party, commanded by Cavalli, got back safely. On April 25 Cagni passed Nansen's furthest north by 25 miles, and the honour of North Polar exploration passed to Italy.

Cagni's party spent forty-five days on the outward march. It took sixty days to make the return journey, because they had to march against the drift of the ice. During nine whole

days the distance they covered to the east was no greater than the distance the ice carried them to the west. For four weeks they struggled desperately to travel faster than the moving ice. On June 13, 1901, they succeeded in reaching Harley Island, the most westerly island in that part of the Arctic Sea, where at last they were free of the danger of the moving ice.

The man who first reached the North Pole was an American, Robert Edwin Peary. Born in Pennsylvania in 1856, Peary set out on his first Arctic expedition in 1886. Accompanied by a Dane, Lieutenant Maigaard, he made a journey on the inland ice of Greenland. They carried no tents, and at a height of 3,000 feet were caught in a gale. They lay down in the shelter of their sledges. Soon they were buried by snow.

Surviving that peril, they returned to the fjord to await better weather conditions; then they set off again, dug their sledges out of the snow, and continued their journey.

Through not wearing snow-shoes Peary fell into a crevasse, but in spite of every hazard they marched on for twelve days, and reached a height which they estimated at about 7,500 feet. There they were snowed under for forty-eight hours, nearly 100 miles inland from the sea. They had to turn back from that point.

From 1898 to 1902 Peary tried to reach the North Pole. In the *Windward* he sailed to Cape D'Urville, some 700 miles from the Pole. Bad ice conditions blocked her further passage.

Peary began to explore to the north by the light of the winter moons. He tried first towards the end of October. Conditions drove him back. Near the end of December he started again. The temperature dropped to 95 degrees of frost. After eighteen days he reached Fort Conger on January 6, 1899.

Peary's feet were frostbitten. But for the quarters and supplies that existed at Fort Conger he would have perished.

He got back to the ship on January 28, travelling 250 miles in eleven days. As a result of this terrible journey in the Arctic mid-winter, Peary had eight of his toes amputated.

The *Windward* returned to the United States. Peary remained at Etah to organize Eskimo assistance in an attempt to reach the North Pole. He tried the Greenland route, but found it impossible. He wintered at Fort Conger. In the spring of 1901 he essayed the Hecla route, failed to reach the Arctic Ocean, and turned back at Lincoln Bay. He then moved his base south to Payer Harbour for the winter. There six of his Eskimos died.

Undaunted, Peary tried again in 1902. Reaching Fort Conger in twelve marches, he left there on February 24, and reached the Arctic Ocean with nine sledges. On April 8 with seven men and six sledges he entered the ice, where he found travel hard and slow. Strong gales often separated even the heaviest floes and kept the party stormbound. At his farthest point observations showed him to be 395 miles from the Pole.

In 1905 Peary began anew. A special ship, the *Roosevelt*, was built for polar service. He wintered on the north-eastern coast of Grant Land. With better equipment than anyone had had before, together with a large number of Eskimos and their dogs, he felt sure he would succeed. The ice, however, was so bad that he was forced to turn back when 200 miles from the Pole. Although he failed to reach the North Pole, this was a world record.

Peary made his final voyage in the *Roosevelt*, lavishly equipped by the Peary Arctic Club. His companions were students, keen on the work of exploration and research.

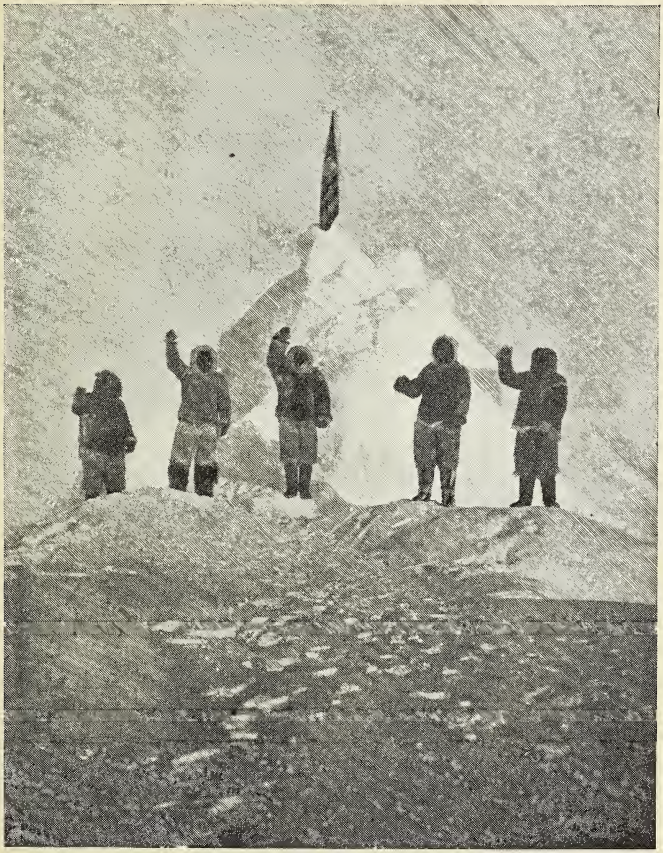
The *Roosevelt* left Etah on August 18, 1908, after taking on board 49 Eskimos and 226 dogs; she wintered at Cape Sheridan. Working until November 5, the field parties laid depôts of supplies as far as Cape Columbia.

The journey towards the Pole began on February 15, 1909. Peary left Cape Columbia on March 1, with 24 men, 19 sledges and 133 dogs. The march was made in two divisions. The first, with Bartlett, Hansen and Marvin alternately in charge, preceded Peary's division by a day and cleared the trail for its advance.

The past winter had been very severe. The thermometer showed 84 degrees of frost. Everyone expected to find the Arctic Ocean an unbroken expanse of heavy ice. Instead, they found broken ice. Peary said this was due to the combined action of tides and currents, which separated the main floes and then crushed them together so that they rose into high ridges. There were large areas of open water. These conditions made it almost impossible for the party to proceed. But after passing the area of shallow water that runs out from the land, the ice improved. A sounding showed the deeper sea-bed to be 1,950 feet below the ice.

The supporting parties returned one after the other while the march proceeded. Goodsell turned back when they were 415 miles from the Pole: Borup when 307: Marvin when 232. Marvin never got back. He was supposed to have perished by drowning, but it was found later that he was killed by one of the Eskimos after an argument about the methods of march. The last supporting sledge, under Bartlett, went back when 152 miles from the goal.

That Peary entered regions close to the Pole was certain. His claim of having reached the Pole was accepted by some geographical societies. But other societies and some Arctic explorers were doubtful of his accuracy. The reasons for their doubts were the character of the ice shown by Peary's photographs: the condition of the dogs, worn down by hard travel: the unsurpassed speed of travel over rough sea-ice for a distance that must have far exceeded 530 miles: that with tired dogs he



Five Members of Peary's Party at the North Pole, photographed by Peary himself. The American Flag has been erected in the snow.

beat the return journey of his supporting parties with fresher teams: his inaccuracies on earlier journeys.

Dr. Cook, who accompanied Peary in 1891–2 as surgeon, claimed to have reached the North Pole in 1908 before Peary. His field experiences on the ice in 1907–8 were most remarkable. Starting with a small amount of food, Cook, with two Eskimos, lived on the country for fourteen months—one entire winter and part of another. For about seven months they were in total darkness.

He crossed Grant Land, and entered the ice of the great frozen sea about 484 miles from the Pole. How far north he proceeded will never be known. He returned safely with his two natives, without food and in conditions of almost utter exhaustion.

A dispute followed over the claims of Peary and Cook. Cook sent two documents to the Council of Copenhagen University. After a long enquiry, the Council decided that the documents did not prove that Dr. Cook had reached the North Pole. This verdict, announced in December, 1909, was accepted as final.

Peary's description of the ice at the Pole has since been confirmed. And so Peary is acknowledged to be the first man to reach the North Pole, a journey over an ice-covered ocean where no land exists.

QUESTIONS

1. Explorers usually try to keep their ships from becoming ice-bound. What was the reason why Nansen set out to do the very opposite? How was it that Nansen knew how to do what he did with his ship?

2. Look at the plan at the end of the book, and then say why the *Fram* did not get as close to the North Pole as the wreckage of the *Jeannette*.

3. Look at the plan at the end of the book; then trace from memory on your own map the polar journeys mentioned in this chapter. Check the result.

4. The Antarctic Ocean surrounds a continent with a high plateau. What is the difference between the Antarctic and the Arctic Oceans?

CHAPTER 3

THE DISCOVERIES OF MEDICINE

IT may seem strange to include this chapter in this book, but remember that man lives between two extremes. Greater than himself are distance, space and time: the world: the universe with its planets, stars and sun: outside that again the other universes which exist beyond our own. Lesser than himself are the atoms of which all matter is composed: all forms of life smaller than his own: the forces man controls, such as engines and dynamos, ships, motor-cars and railway trains.

Among these smaller things are: the cells of which our own bodies are built up; individual living things, many of them invisible to the eye without the aid of powerful lenses to assist our sight: and some of these hidden things cause many of the illnesses from which man suffers.

So there is exploration into the unknown spaces of the earth, and there is exploration (or research) among the unseen and unknown lesser things. Both forms of exploration may lead to discoveries.

Often the delvers into the lesser world have been untrained in a medical sense. They have been impelled to undertake the work by an urge similar to that which has sent the explorer out into the Polar seas.

Modern medical discoveries cannot be considered as the work of any one man. Whole groups of men (and of women) have played their part in the development of medical and

surgical science. But certain names stand out. And, in telling the story of this branch of man's exploratory work, it is possible to indicate some of the principal advances by describing the work of certain notable investigators.

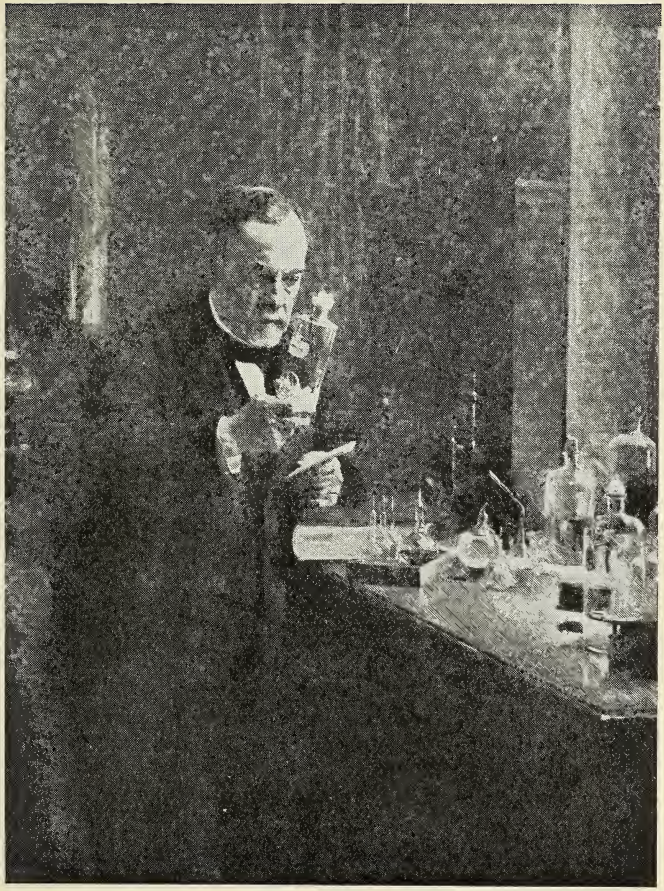
Before the twentieth century there were three people whose work was of special importance. One was Louis Pasteur, who originated the germ theory.

Imagine one's own body as a separate world. Sometimes this world is invaded by tiny organisms which attach themselves to one particular part, or which find their way into the blood-stream. The irritation produces fever, and other complications.

In olden times sufferers were treated by " blood letting "; opening one of the veins and allowing blood to escape, or by attaching leeches to suck the blood from one's body. So doctors were called " Leeches."

Pasteur felt this was not right. He decided that diseases caused by invading germs could only be cured by putting a counter-agent into the body to fight them. He began the method of curing by injection. He cured sufferers from hydrophobia, diphtheria and other ills. His method of attacking diseases caused by microbes has been developed to a standard which has taken the terror from them. Pasteur, although not a doctor, pointed the way.

There are forms of disease, however, that cannot be dealt with in this way. Sometimes it is necessary to remove the affected part by a surgical operation. I remember visiting a monastery in Castile, in Spain, where I saw the crude instruments surgeons used two hundred years ago. There were hammers, chisels, saws, and forceps, which to-day you and I would consider crude for working even on wood. At that time operations must have been very painful and not often successful, for, apart from the crude instruments and the lack of know-



Pasteur at Work in His Laboratory.
From the Painting by A. Edelfelt.)

ledge, there was the danger that the wound made by the surgeon would become unclean and cause blood poisoning. No one knew why the wounds became unclean.

In 1865 Professor Lister decided that Pasteur was right and that microbes or germs were the cause. He decided to try to destroy all microbes that had entered the wound and to prevent the entry of others. He heard that carbolic acid had been used with success to provide cleanliness in sewers, and he decided to try its effect on wounds.

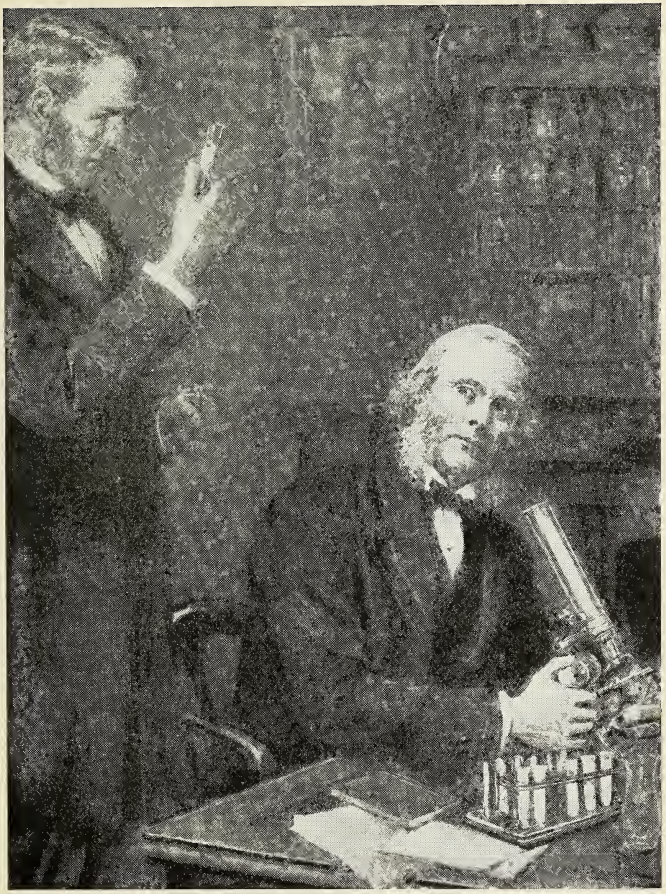
He treated his first case in March, 1865. It was unsuccessful, but in August of the same year the second one did well. Encouraged by that success, he continued to work upon the germ theory. It was not long before his theory was proved correct. His methods gave a new success to surgery, and his work conferred a great boon upon mankind.

In the trenches during the Great War, where conditions for infection by microbes were very bad, I cut one of my thumbs to the bone. Before Lister's time this would have resulted in acute blood poisoning; my arm might have had to be amputated. But bathing the wound in a solution of carbolic acid and dressing it with carbolic lint kept it clean and enabled it to heal very rapidly.

To-day, everyone who suffers from any cut can have it healed quickly. When you find this in your own case, remember that the man who made the discovery from which you benefit was Lister.

Have you heard of radium? Of course. Yet it was only in the twentieth century that radium was discovered. It happened in this way.

In 1895 the world was stirred by the discovery of X-rays. These rays are produced by electricity. Röntgen, the German professor who discovered them, showed how they could penetrate flesh and many other substances. X-rays are now used



Lister in His Laboratory.

to examine bones, and to find out the exact location of disease in the body. They help doctors and surgeons to decide how to cure diseases which otherwise might defeat them. A small X-ray apparatus has been made for dentists to take photographs of the roots of teeth to see if they are healthy. It is even possible to find out whether one's digestion is working properly by eating a special substance which shows on the X-ray photograph.

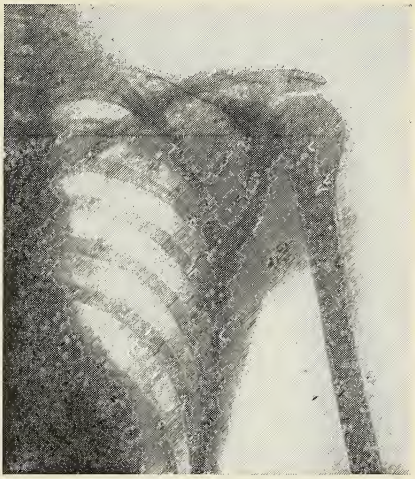
An officer who was in the Tirah Campaign of 1897, in India, told me of one instance of the early use of X-rays. The Ghurka troops were equipped with sheepskin jackets. One man was wounded by a bullet which penetrated his sheepskin sleeve and lodged in his arm. Doctors failed to recover the bullet by probing and did not even succeed in locating it. The Ghurka's arm began to swell very badly and blood poisoning set in. It was thought that it would be necessary to amputate his arm. An officer in this expedition had come out from England with a small X-ray apparatus. He took a photograph of the injured arm. The photograph showed how the bullet had carried some of the wool of the sheepskin into the Ghurka's arm. The wool prevented the probe from finding the bullet. When the doctors saw the X-ray photograph, the bullet and the wool were soon extracted. A month later the wound had almost completely healed, and the Ghurka's arm was saved.

The discovery of radium followed that of X-rays. In 1896 Becquerel found that a heavy metal called *Uranium* gave off rays. Becquerel's friends, Pierre and Marie Curie, were most interested in his discovery. Like Becquerel, Pierre Curie was a Frenchman. His wife was Polish. The Curies began to test all the known elements to find if any others gave out these curious rays.

Mme. Curie used a little instrument called the electroscope,

which is fitted with leaves of fine gold foil. When these leaves carry electricity, the rays (sent out by what we call radio-active substances) make the leaves collapse. The speed at which the leaves collapse shows the radio-active strength affecting them.

Uranium is extracted from an ore called pitchblende. When Mme. Curie tested pitchblende she found the rays four times as strong as she expected. She decided there was some other ray-giving substance far more powerful than uranium in the pitchblende. The Curies determined to find it.



An X-Ray Photograph showing a Broken Shoulder Blade.

They needed a large quantity of ore for their experiments. They had not enough money to buy it. But the Austrian Government sent them a ton of pitchblende from their mines, a present worth more than two thousand pounds.

The Curies then began to search through this large quantity of intensely hard rock to find the unknown substance. Work had to be done over and over again. Weeks passed while they searched. Then a strong radio-active substance was found. Mme. Curie called it polonium, after her own native country. But this was not the end of the search.

Mme. Curie kept on. At last, in 1902, she obtained a new substance in a quantity just sufficient to fill a small saltspoon. It was a radium salt.

Their work took four years. It was difficult and dangerous. No one understood the danger of the rays that were given off. Pierre Curie's hands were badly damaged by handling the tubes they used in their experiments.

Radium is one of the most valuable substances in the world. It is used by doctors for the treatment of disease, for its powerful rays have curative properties for some of the most deadly diseases of to-day.

Malaria was one of the most dreaded diseases of tropical countries. For centuries everyone thought it was caused by poisonous air or water.

A British army surgeon, Major Ronald Ross, discovered that malaria was carried by mosquitoes. Studying the problem, he found that he could infect birds with malaria through a mosquito bite. He showed that human beings caught the disease in the same way. Later, through further experiments, it was proved that the belief that air or water could produce malaria, even in districts where it was very bad, was wrong.

Malaria follows only after the bite of a particular type of mosquito. This mosquito is known as the anopheles mosquito. It is different from other mosquitoes that bite mankind. It can always be recognized from other varieties because it stands on its head when it bites.

When a mosquito bites it sucks blood. The ordinary mosquito draws the blood straight into its stomach. The anopheles mosquito, however, has a bag between its proboscis and its stomach; when it sucks blood this bag overfills and a small quantity of the blood is re-injected into the man. Malarial germs are introduced into the body with this re-injection of one's own blood.

Armed with this knowledge, it was comparatively easy to stamp out malaria and other diseases, such as yellow fever, which are carried in a similar way. Mosquitoes breed in swamps and stagnant water. By spraying paraffin upon stretches of water where they breed, mosquitoes and their larvæ can be killed.

Through the work of Major (later Sir) Ronald Ross, areas of the world that used to be deadly haunts of malaria and yellow fever are now healthy. With proper protection against insects these districts are perfectly safe to live in.

QUESTIONS

1. Mention some of the extremes between which man lives. Mention some of the forces man controls.
2. Pasteur and Lister created a complete change in the method of treating certain diseases and of treating wounds. What was the theory which led to the changes which they introduced?
3. What was the peculiar property of the substance, Radium, which the Curies discovered that makes it valuable to mankind? How was their discovery similar in character to the discovery made by Röntgen?
4. How is malaria carried from one person to another? How can malaria be stamped out?

CHAPTER 4

THE PANAMA CANAL

YOU know what an isthmus is—a narrow strip of land connecting two wider areas of land. The isthmus of Panama connects North and South America, and separates the Pacific Ocean from the Caribbean Sea. The Caribbean Sea has outlets to the Gulf of Mexico and to the Atlantic Ocean.

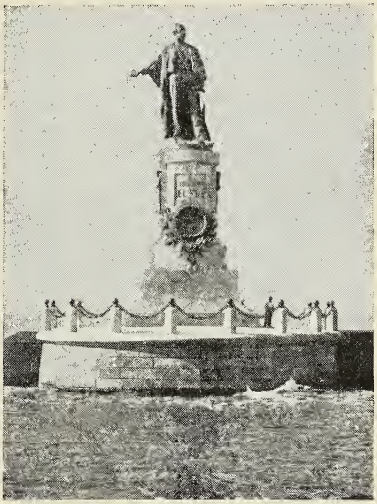
If you look at the map, you will see how the Caribbean Sea is enclosed by islands, all the way from Trinidad to Florida. At one time the Caribbean Sea and the Gulf of Mexico may have been inland seas, perhaps one large lake, but the battering of the seas from the hurricanes that arise in that part of the world probably broke through the chain of land and formed the islands.

These islands were called the West Indies by Columbus because he thought that he had reached India when he discovered them in 1492. They form a barrier which shelters the southern coast of the Caribbean Sea. The isthmus of Panama is further protected on both sides by comparatively shallow water. Its southern shore faces the Pacific Ocean, a far more tranquil ocean than the Atlantic. So this isthmus was never cut open by Nature.

Balboa, the first man who sighted the Pacific Ocean on the far side of Panama, believed that he was looking upon an ocean which spread to the south, instead of to the west, as you can see on the map. He made this mistake because the

isthmus of Panama runs east and west, whereas the Continent of America runs north and south. But in those early days no one had any idea of the true shape of the American Continent.

For many years men tried to find a passage from the east to the Pacific Ocean. Early in the eighteenth century Magellan found the passage which has since been called the Magellan Straits. In Chapter 1, I told you that Amundsen found a way past Northern Canada, which had long been sought as the North-West Passage. Both involve a long way round to the western shores of the American Continent. So, to make a shorter route, men turned their attention to the isthmus of Panama.



The statue of Ferdinand de Lesseps at the entrance to the Suez Canal at Port Said.

The Suez Canal had been already cut to provide passage from the Mediterranean into the Red Sea and the Arabian Ocean to shorten the route for ships travelling to East Africa, India and the Far East. This Canal was cut by a Frenchman called Ferdinand de Lesseps, who also promoted the cutting of the Corinth Canal. Following these successes, he naturally turned his attention to the other outstanding part of the world where a canal was required.

When de Lesseps took charge of the work he said: " The

Panama Canal will be more easily begun, finished and maintained than the Suez Canal." He was wrong.

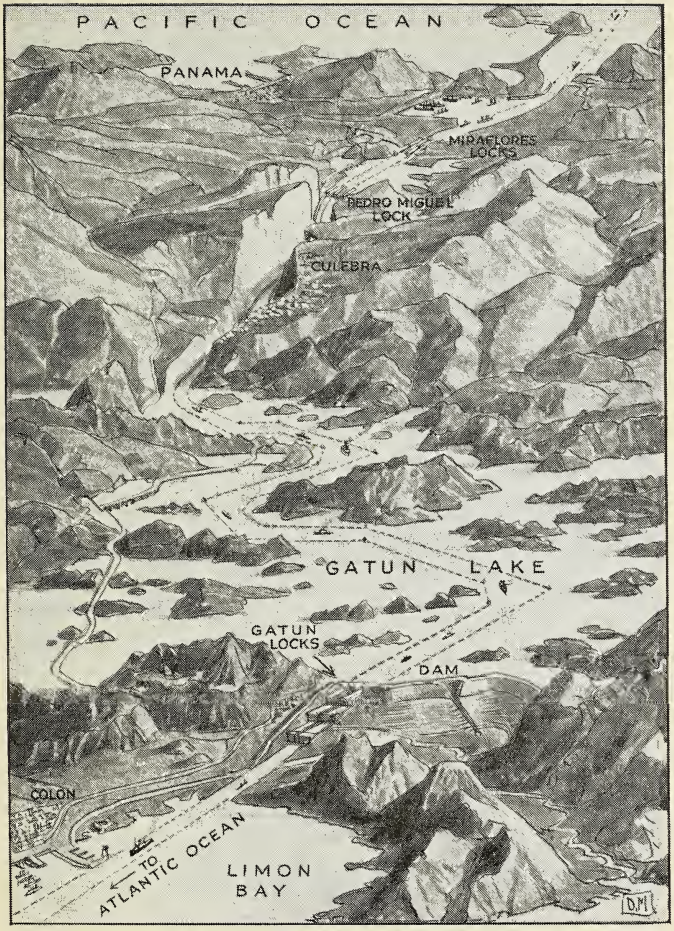
Like other pioneers of whom I have already told you, de Lesseps was really untrained for this work. He was not an engineer, and his knowledge of engineering was limited. But his successes with the Suez and Corinth Canals made him proud, and intolerant of technical advice. He planned the work for the Panama Canal without getting the full information which a trained engineer would have known to be necessary. After nine years of effort, his company failed in December, 1888. It was financed by the French, and many poor people lost their savings in his failure.

A new company took over the work in October, 1894. De Lesseps had intended to cut his canal to sea level. The new company proposed to raise it nearly 100 feet above the sea. But the second company failed too.

One of the great difficulties which these early workers had to contend with was yellow fever and malaria. Both caused a very high death rate among the workers, which no doubt played a big part in the failure of the early attempts to make the Canal.

The war between Spain and the United States in 1898 attracted popular interest in America to the Panama Canal. The American people became convinced that the venture must be taken over by the United States because of its importance as a means of inter-connecting their east and west coasts by sea. A Commission was appointed in the following year to go into the question and report how it could best be carried out.

Up to the end of 1901 sixty million pounds had been spent by the first two companies without reaching success. Only one-fifth of this sum had resulted in real engineering work, and in January, 1902, the second Panama Canal Company sold its property to the United States for eight million pounds.



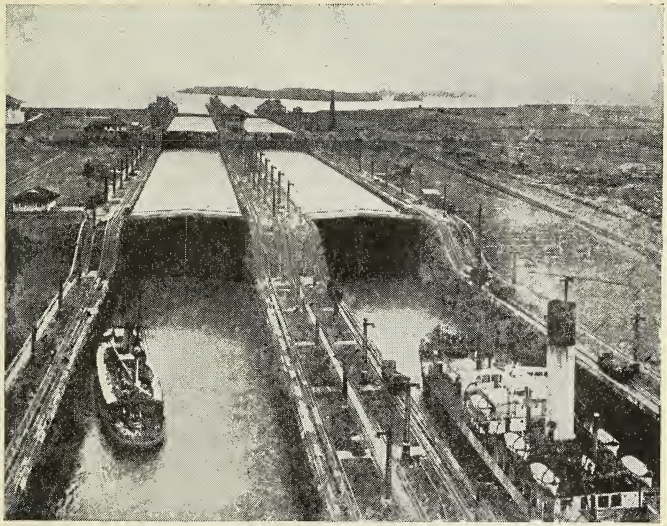
Map of the Panama Canal, showing the difficult country through which the Canal was cut.

At that time Panama belonged to Colombia. Early in the following year Colombia refused to allow the United States to proceed with the Canal. In November, 1903, Panama revolted from Colombian rule and became an independent Republic. Within a month Panama granted to the United States the right to use, occupy, and control a stretch of land 10 miles wide, which is known as the Panama Canal Zone. The United States paid Panama two million pounds at the time; for eight years there was no further payment; since then the United States pays Panama fifty thousand pounds every year.

Shortly after signing the treaty, the United States Government sent a Commission of Inspection to Panama to make a complete examination of health conditions. Armed with the knowledge of the discoveries of Major Ronald Ross, the Commission drew up a plan for the sanitation of the unhealthy tropical area. Houses were protected with wire screens over windows and doors so that mosquitoes could not enter. Infected houses were carefully fumigated. Swamps and stagnant water, the breeding places of mosquitoes, were drained. And from one of the most unhealthy places in the world the Canal Zone of Panama was converted into one of the most healthy.

Three years were devoted to work of sanitation: banishing yellow fever and malaria; erecting operating plant; modernizing railways; building living-quarters and creating food and water supplies for the working force.

Including expenditure for naval and military defence, the Canal cost the United States £73,330,000. It took nearly ten years to complete. Through the breaking of walls during construction, slides of earth fell into the cuts. This happened thirty times, and added over 25 per cent. to the amount of earth excavated. The first ocean steamer passed through the canal on August 3, 1914.



The Locks at Gatun, Panama Canal. Ships are moved through the Locks by the Electric Trucks seen on the Lock Parapets. The two pairs of gates in the foreground of the picture are about to open. Gatun Lake shows beyond the Locks at the top of the picture.

The completed Canal has six pairs of locks. Each lock is a separate chamber, with walls and floor of concrete, 1,000 feet long and 110 feet wide, and water-tight gates at each end. The gates are made of steel. They are 7 feet thick, 65 feet across, from 47 to 82 feet high, and weigh from 300 to 600 tons each.

The time required to fill or empty a lock is about 15 minutes. A vessel takes about three hours to pass through all six locks, and about 10 to 12 hours to pass through the entire Canal.

The Canal is 40·27 miles in length from shore-line to shore-line. It runs due south from its entrance in Limon Bay, and at Gatun passes through three pairs of locks which

raise the level to 85 feet. This stretch covers 11½ miles, and provides entry into Gatun Lake, which is 24 miles long. Ships can pass at full speed across the lake. From the other side of Gatun Lake the Canal runs south-east. At Pedro Miguel it passes through one pair of locks with a drop of 30 feet, and at Miraflores through two pairs of locks with a drop of 54 feet. These locks bring the water to the level of the Pacific Ocean. The south end of the Canal enters the Bay of Panama about 22½ miles east of the north end.

Before completion this great engineering feat occupied the attention of men for 35 years. It is a splendid example of the practical results of exploration and discovery. In Panama there was the need to explore the best route through which to cut the Canal, while an alternative route in Nicaragua was also explored. There was the need to apply the discoveries of Major Ross to free the unhealthy tropical zone of disease. There was the need to discover and apply principles of engineering to achieve success.

And where Balboa gazed to the south and wrongly named the ocean that lay before him the Great South Sea, there is to-day, through the application of modern engineering following upon exploration and discovery, a means for ships to pass from the Pacific to the Atlantic Ocean and back again, which shortens the sea distances between European ports and the Pacific coast of North and South America by 6,000 miles.

QUESTIONS

1. What was the natural reason that caused Balboa to name the Pacific Ocean the Great South Sea? The Atlantic lies to the east, the Pacific to the west of America: in which direction does the Panama Canal run?
2. Look at the map at the beginning of the book, and then describe in your own words the reasons why attempts were made to create the Panama Canal.
3. How was the work of Sir Ronald Ross (described in Chapter 3) of the greatest assistance in helping to make the Panama Canal possible?
4. Describe in your own words how the completion of the Panama Canal was really a triumph for exploration and discovery.

CHAPTER 5

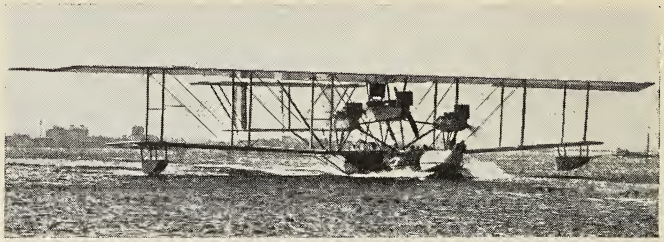
CONQUERING THE ATLANTIC BY AIR

BY the time aviation became a practical means for travel the habitable parts of the earth were properly mapped. But the air conditions above many of these parts of the earth were still unknown. Between the inhabited areas there were stretches of ocean and desert over which the airways were completely unexplored. Aerodromes existed only in the more civilized countries. Air routes had to be explored over jungle and desert and ocean before they could be organized for regular use. These pioneer flights were difficult and dangerous.

The first exploratory flight to attract the attention of air pioneers was the crossing of the North Atlantic Ocean. There were rival bids to link the Old World and the New by air. First across the Atlantic by air to England was Lieut.-Commander A. C. Read and his crew in an American Naval Curtiss flying-boat. Four of these flying-boats started from Newfoundland on May 16, 1919. Only one succeeded in reaching England. After stops at the Azores and Lisbon, Lieut.-Commander Read's flying-boat landed at Plymouth on May 27, 1919.

The first non-stop flight across the Atlantic took place a month later. The *Daily Mail* had offered a prize of £10,000 for the first direct flight across the Atlantic. Eight aeroplanes collected to essay the ocean flight. Five were British.

Only two of the five British aeroplanes actually started the



The Naval Curtiss Flying Boat No. 3 that Crossed the Atlantic.

flight. They made their base near St. Johns, Newfoundland, the point of the American Continent that lies nearest to Europe.

With Commander Mackenzie Grieve as his navigator, Mr. Harry Hawker started first. When he was 800 miles off the Irish coast (mid-way across the ocean) Hawker was forced to alight in the sea owing to a defect in the water-cooling system of his engine. He brought the machine down alongside a small fishing vessel which did not carry wireless. For nearly a week everyone believed that the gallant flyers had been lost. Then the vessel called at its first port, Lerwick, in the Shetland Islands. The news of their safety thrilled everyone with their daring adventure. Hawker sent the following message to the *Daily Mail*:

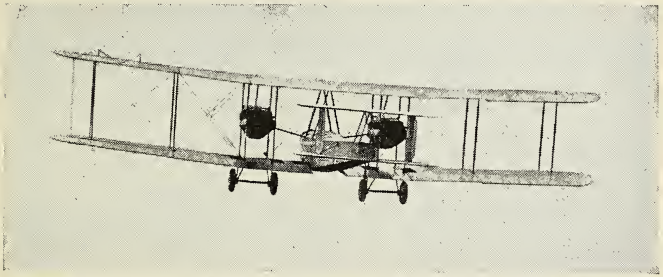
> " My machine stopped owing to the water filter . . . being blocked up with refuse, such as solder and the like, shaking loose in the radiator.
>
> " It was no fault of the motor. The motor ran absolutely perfectly from start to finish, even when all the water had boiled away. I had no trouble in landing in the sea. We were picked up by the tramp ship *Mary*, after being in the water 1½ hours."

On June 14, 1919, Captain John Alcock, with Lieut.

Arthur Whitten Brown as navigator, rose from St. Johns in a Vickers " Vimy " biplane, fitted with two Rolls-Royce engines, which together developed 750 horse-power. Over the Atlantic Ocean the weather was bad, with heavy clouds, rain and a strong west wind. During part of the flight the aeroplane was covered with ice. At one time the speed indicator became clogged. But the aeroplane flew on at an average speed of 118 miles an hour. Fifteen hours 57 minutes after rising it came down in boggy ground at Clifden, in Galway, Ireland. The big 'plane tipped up on to its nose when its wheels stuck in the soft ground. This mishap prevented the airmen from continuing their journey to London.

This flight gave to Britain the proud heritage of the first non-stop flight across the North Atlantic, and Captain Alcock and Lieut. Brown richly deserved the honour of knighthood which the King conferred upon them in recognition of their feat. Unfortunately, Sir John Alcock was killed on December 18 of the same year when his aeroplane crashed while flying through fog over France on the way from London to Paris.

Nearly three weeks later, the British rigid airship, R.34,



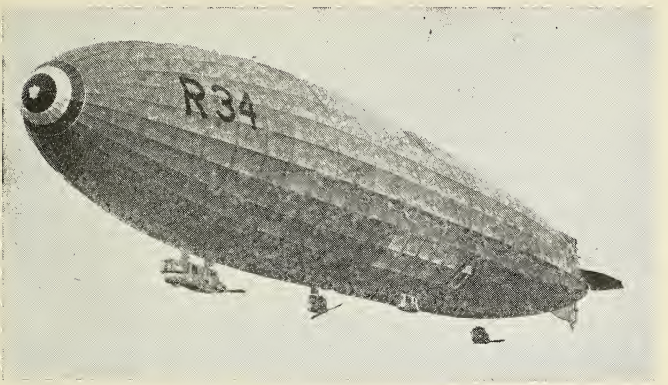
The Vickers *Vimy* Aeroplane used on the First Non-stop Flight across the Atlantic.

left East Fortune, Scotland, for the United States. Brigadier-General E. M. Maitland, who flew in R.34, wrote:

> "The Air Ministry have several definite objectives in sending R.34 upon this flight.
>
> "Firstly, the acquisition of information and data concerning conditions in the Atlantic during an extended flight: not only from the point of view of the Airship pilot, but also from the point of view of the Meteorologist.
>
> "Secondly, to demonstrate the possibilities of large Rigid Airships with regard to carrying out long oversea voyages; and finally, by actually landing in the United States of America, to show our friends across the Atlantic our newest type of Airship, and at the same time to forge a new link, by way of the air, between the Old World and the New.
>
> "What more wonderful or more delightful adventure could any one be called upon to undertake?
>
> "We one and all have the greatest confidence both in our Captain and in our Airship, and it is never a question of 'Are we going to get to America?' but 'How long will it take us to get to America?'"

Commanded by Major G. H. Scott, with a crew of thirty men, the airship covered a distance of 3,600 miles at an average speed of $33\frac{1}{3}$ miles an hour. After a flight of 108 hours she arrived safely at Hazelhurst Field, Long Island, New York. Three days later she ascended for the return trip. She took a slightly longer route back, but, helped by favourable winds, the airship flew 3,800 miles at $50\frac{2}{3}$ miles an hour. After a flight of 75 hours she descended at Pulham airship station in Norfolk.

This was the first Transatlantic flight by airship. It was made to determine the possibility of Transatlantic services by air. The flight was comparatively uneventful. Its success reflected the greatest credit on the designers of this British airship and on the officers and crew who were responsible for her handling during the flight. It was not until August, 1930,



The Giant Airship, R.34, in Flight.

that another British airship flew the Atlantic. In that month R.100 flew to Montreal and back, making the return journey in 57 hours.

In the meantime Brigadier-General Maitland was killed in the disaster of the R.38 when she broke up over the River Humber in 1921; while Major G. H. Scott, who was the Captain of the R.34 on her Transatlantic flight, was killed when R.101 crashed in France while on her way to India, in October, 1930. These accidents made the British Government decide against the use of airships.

The next great Atlantic flight was made by Charles Lindbergh. His father, born in Stockholm, Sweden, had gone to America and become an American citizen. His mother was of English, Irish and French extraction.

Charles Lindbergh was born in Detroit, Michigan, on February 4, 1902. He began to fly when he was twenty years old, became a cadet in the American Army Air Service, gained his pilot's wings and was commissioned as Second

Lieutenant in the Reserve. Then he flew as an exhibition pilot, an instructor, and an air mail pilot.

A prize of £5,000 was offered for a non-stop flight between New York and Paris. Several pilots determined to gain this prize. Among them was Lindbergh. He found a number of men in St. Louis who were willing to assist him financially. In December, 1926, he went to New York to make enquiries about aeroplanes and engines. He decided to use an aeroplane called the Ryan with a Wright engine of 200 horse-power. He placed an order for the machine on the last day of February, 1927.

On May 10, 1927, Lindbergh rose from San Diego at five minutes to four in the afternoon. He flew over ridges of mountains, then above the desert and the Salton Sea. By sunset he was over the deserts and mountains of Western Arizona. It was a beautiful moonlight night. Below his 'plane he saw the changing country, with snow-capped ridges, deserts and fertile valleys. With 500 feet to spare he flew over one mountain range that rose to over 12,000 feet. He landed at St. Louis at 8.20 in the morning. Next day he flew on to New York.

At 7.40 in the morning of May 20, he started from New York for Paris. The weather up to the southern half of Nova Scotia was good; then he flew through a number of cloud-bursts. Between Nova Scotia and Newfoundland the ocean was covered with cakes of ice, and after St. Johns, Newfoundland, there were numerous icebergs.

Darkness fell and fog began to form over the sea. It became thicker and deeper. Two hours later Lindbergh was skimming the top of the clouds at about 10,000 feet. The moon had not risen and it was very dark. Some clouds rose higher than the 'plane; when Lindbergh tried to fly through one, sleet began to collect on his aeroplane. He turned back

into clear air, for there was danger of ice forming on the wings and making the aeroplane too heavy to fly. After that he flew round clouds he could not pass over. When the moon rose, after two hours of darkness, flying was much easier.

At sunrise the clouds were more broken. The temperature rose. There was no further danger of ice forming on the 'plane. Holes appeared in the fog. Lindbergh glided down through one until he was less than 100 feet above the water. A strong wind blew from the north-west; the surface of the ocean was covered with white horses; but the wind was friendly, helping him on his way.

The clear patch changed to fog. He passed blindly through it at a height of 1,500 feet for nearly two hours before the water became visible again. The sun struck through patches of fog. Mirages appeared, creating false shorelines with trees standing up above the horizon. But Lindbergh knew there were no islands in mid-Atlantic. He saw no ships.

For a long time he flew close to the water, sometimes as low as 10 feet and rarely higher than 200. He checked the wind direction from the white tops of the waves to enable him to steer his 'plane correctly.

Near the coast of Europe he saw a number of porpoises and a few birds. He passed above small groups of fishing-boats. He tried to shout to the man in one boat, but could not make out any answer.

Less than an hour later he saw a mountain coastline to the north-east, about 10 to 15 miles away. He changed his course to strike the nearest point of land, and recognized Valentia and the south of Ireland. After that he was seldom out of sight of ships.

Just over two hours later he saw the coast of England. Passing a little south of Plymouth, he flew on over the English Channel. After he crossed the French coast at Cherbourg the sun set. He could see the beacons of the Paris–London airway.

Shortly before 10 o'clock he saw the lights of Paris, and a few minutes later circled high above the Eiffel Tower. Picking up the lights of Le Bourgêt aerodrome, he spiralled down until he could see the long lines of hangars and the roadway packed with motor-cars. He circled into the wind and landed.

This flight, completed in $33\frac{1}{2}$ hours, was the first Transatlantic flight made by one man flying alone. Lindbergh depended entirely upon his own resources to pilot and to navigate. The aeroplane was not equipped with wireless, and the accuracy of his flight from New York to Paris, through fog, clouds and drizzle as well as clear weather, was remarkable. This flight proved that the Atlantic could be spanned by air by one man entirely unassisted, and by that proof paved the way for the regular Transatlantic air services between the Old World and the New.

The North Atlantic winds generally blow from America to Europe. This makes a flight towards Europe easier, because it can be completed in a shorter time.

In spite of several attempts, twelve months passed before the first aeroplane succeeded in crossing from Europe to America non-stop. As was the case when Lindbergh made his flight from New York to Paris, other 'planes had started and had come down in the sea, where their occupants had perished.

The only heavier-than-air machines that had crossed from Europe to America were two American Douglas seaplanes, which flew from England in short stages via the Shetland Islands, Iceland, Greenland and Canada, in August, 1924.

A German aeroplane called the *Bremen* was the first to fly across non-stop. Leaving Baldonnel aerodrome, just outside Dublin, in Ireland, on April 11, 1928, this 'plane had a crew of three: two Germans, Captain Hermann Köhl and Baron von Hünefeld, and one Irishman, Commandant J. Fitzmaurice. Köhl and Fitzmaurice were the pilots.

Colonel Lindbergh, with his Aeroplane, the *Spirit of St. Louis.*

After leaving Ireland they flew through good weather until about midway across the Atlantic. There, a solid bank of fog towered from the water high above the height to which their 'plane could climb. To avoid flying through the fog, with its risk of ice formation on the wings, the pilots turned to the north and flew for several hours at right angles to their course. When they came to the northern edge of the fog belt they turned west again, keeping it on their left side. After a number of hours the petrol used by the engine lightened the load in their 'plane and they were able to climb above the fog. They knew they were far to the north of their correct course. So they changed direction once more and flew south-west.

Hour after hour went past, while they saw nothing save the wide expanse of cloud and fog below. Petrol began to run short. Anxiously they watched the fuel gauges which indicated

the quantity left in the tanks. At last there was enough to keep them in the air for only thirty minutes. They had no idea what lay beneath the fog. They had no means of knowing whether they were still over water or whether they had made the coastline and were flying above land. One thing only they knew—that whatever lay below they would be forced to come down within 30 minutes and take what chances might befall.

With that uninspiring prospect facing them, they suddenly saw a gap open underneath. Through it they saw land. They spiralled down through the gap in the fog and found themselves over rocky country—a hopeless place for the safe landing of an aeroplane. They picked out one small patch. In the attempt to land, their 'plane struck rough ground and was damaged beyond the possibility of taking off again.

They were on Greeneley Island, in the Belle Isle Straits between the northern coast of Newfoundland and the southern coast of Labrador. There was a lighthouse near them. Its keepers came to their assistance. With their help the news was sent out to the world that the flyers were safe, and shortly after aeroplanes flew up from New York and took the three daring adventurers on to that city by air.

It is not possible in this chapter to tell the story of subsequent flights across the North Atlantic. The stories told are those of the earliest flights by lighter-than-air and heavier-than-air machines. These are the stories of the pioneer explorers of the airway between North America and Europe: men who fought through flying conditions known to be as bad as those existing in any part of the world: who, by the risks they undertook, helped us to know what was required to make the Atlantic airway safe for the establishment of regular air routes. The fact that the North Atlantic was the last great air route to have regular services projected is proof of the difficulties

and dangers they faced. Regular air services passed over both the South Atlantic and the Pacific: over the Arabian desert and the Sahara; ran to the Dutch East Indies and Australia: round both sides and across the continent of North and South America: up and down the length of Africa, before aviation was ready to conquer the bad old man of the sea—the North Atlantic.

QUESTIONS

1. Why had pioneer flights to be made before regular air routes could be started?
2. Which is the most difficult air route of all?
3. The first non-stop flights across the North Atlantic were made by a British aeroplane and airship. From memory describe what you know of these flights.
4. What is the natural feature that makes a flight from Europe to America more difficult than in the opposite direction across the North Atlantic? Draw on your map three alternative air routes across the North Atlantic.

CHAPTER 6

MOTOR-CAR EXPLORATION THROUGH WILD REGIONS

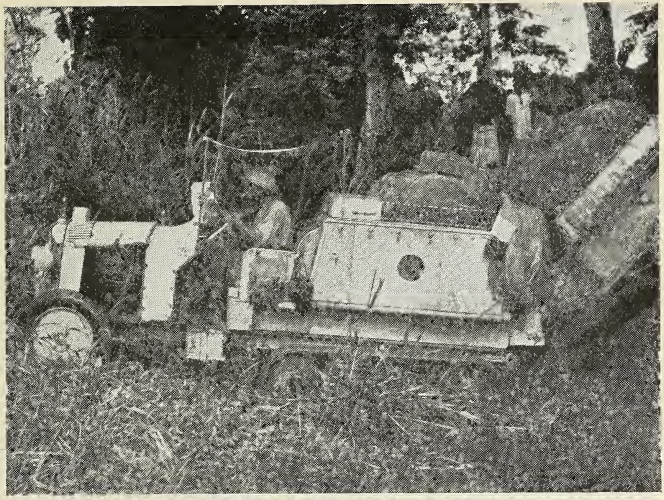
IN 1921 a novel type of motor-car, designed for desert use, was built in the Citröen factory in France. An endless rubber band unrolled under the vehicle to enable it to travel over soft or yielding ground without sinking. Fitted with a 10 horse-power engine, it could travel at 25 to 30 miles an hour. The body had three seats and was fitted to carry boxes of provisions, camp requirements, maps and guns. Guns were necessary, for it was intended to use these motor-cars to cross the Sahara Desert, where travellers must be prepared for self-defence, not only against savage tribes, but against wild animals.

During the first winter a fleet of these motor-cars was tested under the conditions they would meet when crossing the desert. These trials showed that it was necessary to increase the cooling for the engine, and the protection of the working parts from sand.

An expedition of five motor-cars started from Tugurt on December 1, 1922. Each car carried a tent and 4 gallons of water in special tanks. Two of the cars carried reserve supplies of petrol.

Depôts of petrol and provisions had been already placed as far south as In Salah, 600 miles away. The expedition had to carry petrol and food for the 800 miles of unmarked territory beyond In Salah.

Led by Georges-Marie Haardt and Louis Audouin-Du-



One of the Haardt Motor-cars, heavily laden, crossing a difficult piece of country in the North of Tanganyika.

breuil, the expedition covered 2,200 miles in terrific heat without mishap. When it reached Timbuktu safely on January 7, 1923, the Sahara was crossed for the first time by motor-car.

A second expedition was then planned. Preparations occupied more than a year. The new expedition was equipped to carry out serious research and exploration work.

On October 28, 1924, eight motor-cars—painted white to resist the heat rays of the sun—started out across the sandy wastes that the two leaders had crossed before. For some days a series of oases—natural wells surrounded by vegetation—helped their crews to feel in touch with life.

From the last oasis they set out in single file. Ahead of them lay the Tanesruft, a region of absolute desert. The wind was

behind them, and in the broiling heat the men were saturated with their own perspiration, and suffocated with choking red dust. Time and again they stopped the cars and turned to face the wind to seek relief. The cars sank deep into the loose sand of the Tanesruft, and caused them to use more petrol than was expected.

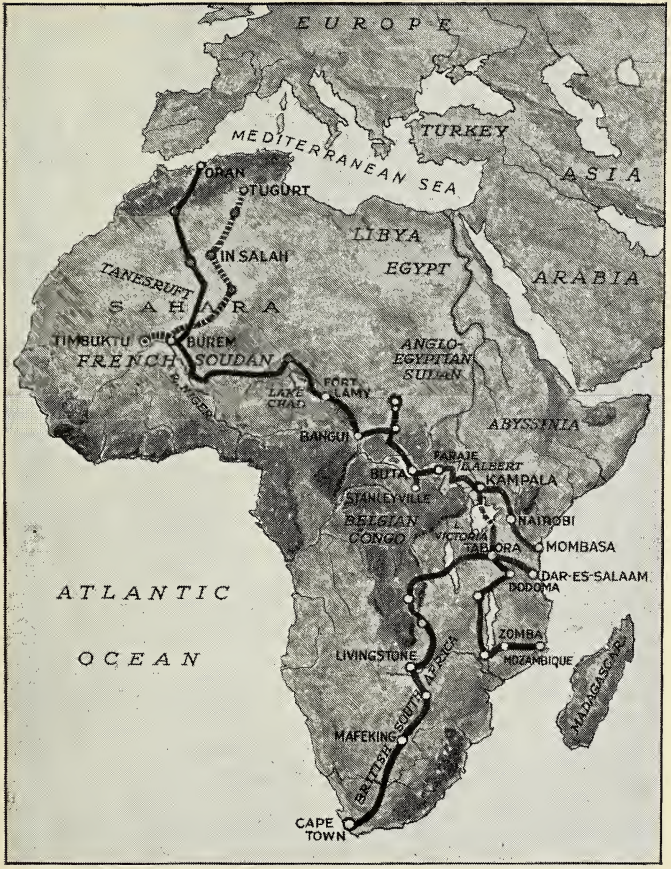
They travelled six days, and spent six nights amid the sand. On the seventh day they saw a few tufts of grass and a lizard, the first sign of life. At last they sighted the walls of Burem, a city on the banks of the great River Niger.

On November 20 the expedition left Burem for Lake Chad. The journey towards that great inland sea of Africa was a severe test. The cars slipped down into natural craters. To climb out on the other side was heavy work. But in spite of all difficulties the expedition reached the shores of Lake Chad on December 14, 1924. There they found mosquitoes in millions. So far the explorers had travelled entirely in French territory, and made the first journey by motor-car from the Mediterranean coast to the lake.

On Christmas Eve they reached Fort Lamy, whence, after a short stay, they moved south again.

They reached the system of roads built by the French in the Ubangi region, where motor-coaches and cars travel regularly at normal speeds. Towards the borders of the Belgian Congo there were sign-posts.

From Bangui (the capital of Ubangi) the expedition turned north towards the boundary of Sudan. They spent some time in hunting and secured specimens of many wild animals. Thence they travelled onward to the great forest of the Belgian Congo. A tornado burst upon them as they neared the jungle. Thunder rolled, lightning flashed and a deluge of tropical rain drove them to take shelter in a deserted village.



The Routes followed by the two Haardt Expeditions through Africa. The dotted line shows the route of the First Expedition; the solid line the route of the Second Expedition.

Entering the Congo, they were in a land of virgin forest. The heat was terrible. The expedition followed a path cut through the forest by forty thousand natives working under the direction of the Belgians. As the expedition proceeded, the undergrowth became heavier, the narrow opening smaller. They felt they were travelling along a forest tunnel. Over this difficult ground the engines of the cars ran perfectly in spite of the heat. No animals appeared. The noise of droning insects, falling leaves, screeching parrots and their own motor-cars were the only sounds they heard. Stanley, the British explorer, passed on foot through this country in 1876, accompanied only by native porters.

Five hundred miles from the frontier the expedition reached Stanleyville, a modern city in the wilds of Africa. Thence the cars returned by the same track to Buta, then drove across the northern portion of the Belgian Congo to British East Africa. The scenery changed. At Faraje, near Lake Albert, agricultural country began. They passed through coffee plantations; fields of millet, sweet potatoes and manioc. At night they crossed the lake to British East Africa by steamship.

At Kampala, Audouin–Dubreuil, with two cars, left for Mombasa. The remainder crossed Lake Victoria by steamer and drove to Tabora. There they divided in three sections. Each section took a different route. Two cars left for Dar-es-Salaam, two for Mozambique and two for Cape Town.

Haardt led the section whose route lay through Nyasaland and Portuguese East Africa to the port of Mozambique.

Let us follow Haardt's section, which entrained for Dodoma on April 30, 1925. The two veteran cars were loaded on to trucks and covered with tarpaulins. Another wagon was loaded with petrol. The engine used wood fuel and sent showers of sparks high into the air. The tarpaulins were

One of the Cars being ferried across the Ruaha River.

damped with buckets of water. In spite of this precaution one of the cars caught fire. The petrol wagon was next to it.

Haardt and his companions shouted and whistled. The train drove on. Haardt fired his revolver. The train stopped. They rushed out to save the precious car. There was no water. They filled pails with sand, and threw the sand on the fire. Some petrol was still in the tank of the car; there was risk of an explosion. When they mastered the fire the car they had driven so many thousands of miles was badly damaged. At Dodoma they set to work to repair it.

On May 4 they reached the Ruaha river. It was 300 feet wide. The current ran at over 12 miles an hour. There was no bridge. Two small canoes were the only means of crossing. Both were in bad condition. They repaired the canoes with

pieces of wood, empty petrol cans, and clay, then took everything out of the first car and loaded it on the canoes.

The water came up the sides of the car. It took four anxious minutes to reach the opposite bank. The car slipped off and its endless band gripped the bank just in time. For the canoes had begun to take in water under its weight and would have sunk in another minute.

When ferrying the second car, the canoes sank and left the car half in and half out of the water. The swift current threatened to carry it away. Quickly a cable was made fast to each car, and just in time the first one towed the second up the bank to safety.

Leaving the river behind, they reached a region where it rains for eight months a year. They lived under grey skies and torrential downpours. For four days their cars slithered through trackless swamps and over grassy plains which were under water. The terrible conditions reduced their speed to 9 miles a day. At Karonga they were told they were the first men to cross that difficult, trackless region.

Beyond Zomba, the capital of Nyasaland, they came upon a marsh 12 miles wide. The cars sank into holes. They sighted the smoke of a brush fire, which marked harder ground, and drove towards it. But the fire suddenly changed direction and began to advance towards them.

Flight was impossible on the spongy soil. Their one hope was to drive through the flames at full speed. The drivers of the cars accelerated. The eyes of the men were filled with smoke. They could see nothing. Suddenly, with a shock, one car stopped. It had run into a burnt-out tree-stump in the middle of the flames. A front tyre burst. The driving bands were almost on fire. Swiftly the damage was put right. The car backed, started forward with a bound, and two minutes later was out of the danger zone.

Later in the day both cars sank in thick mud. It was hard work getting them out. Then water barred further progress. The crews lay down to sleep, 400 miles from Mozambique.

Fortunately, they came upon a road, shortly after leaving the mud. After crossing a deep ravine, which the local natives said was impassable, they sighted the Indian Ocean. They reached Mozambique on June 14, 1925, the first expedition to cross Africa from west to east by motor-car.

In 1928 Haardt began preparations for an expedition to cross Asia from Turkestan to Peking. This expedition left Beirut, Syria, in April, 1931, with six six-wheeled cars, seven endless-band cars and 34 men.

While crossing the Himalayas the stores had to be transferred to ponies time after time to enable the cars to be forced through snow 12 feet deep. At one point it took three days to cover 18 miles.

Near the far end of the 7,500-mile journey unfriendly tribes fired on them. Robbers stole their spare tyres and demanded arms and ammunition before they were returned.

But determination won. The expedition reached Peking with all its cars and members. During preparations for the return journey Haardt caught influenza at Shanghai. Refusing to be nursed, he left for Hong Kong, in readiness for the return trip. He arrived suffering from pneumonia, and there, in March, 1932, he died at the age of forty-seven, one of the pioneers of future transcontinental road routes.

QUESTIONS

1. What was the special feature of the Haardt expedition motor-cars that enabled them to travel over trackless sand and mud?
2. Trace on your own map the routes of the expeditions led by Haardt across Africa.
3. Name the countries that own the territories crossed by these expeditions.
4. The second African expedition had Mombasa, Dar-es-Salaam, Mozambique and Cape Town for its destinations. Look at the map and see where these places lie and then say to which countries they belong.

CHAPTER 7

FOSSIL HUNTING IN THE GOBI DESERT

THE Gobi Desert covers a greater area than Great Britain, Germany, France and Spain. This Mongolian desert lies 2,000 to 3,000 feet above the sea. High mountain chains surround it, while others break its general level.

In prehistoric days this now desolate region was an inland sea, of about the same size as the Mediterranean. Then the mountain chains were sea-girt land, as Italy, Greece, Corsica and Sardinia are to-day. The Gobi Sea was a centre of animal and human life.

The bleak boundaries of the Gobi Desert are constantly extending as the wind carries the sand ever further afield. Marco Polo, who made a journey from Europe to China, wrote of the Gobi Desert nearly 700 years ago that its length was " so great that it would take a year and more to ride from one end of it to the other. It is all composed of hills and valleys of sand."

Doctor Roy Chapman Andrews, an American explorer who had made several expeditions to the Gobi Desert in search of the fossil remains of prehistoric animals, planned to take a motor expedition there in 1921. This expedition had two main objects—the discovery and collection of fossil animal remains and of specimens of rare living animals.

Doctor Andrews took three motor-cars, two one-ton lorries and eighteen tons of stores and equipment across the Pacific by sea to China. On his arrival he encountered a terrific

A Takin, a Herd of which Dr. Andrews' Party Hunted.

sandstorm. There had been no rain in northern China for fourteen months. The air, even far over the sea, was thick with yellow dust. Peking lay under a pall of dust that looked like a London fog.

Andrews was too experienced an explorer to take unnecessary risks. He spent a year in China making preparations to penetrate the Gobi Desert. During this period the party had an exciting adventure when hunting a rare creature called the takin. The Chinese call the takin a wild cow; it is actually a goat-antelope which lives among high and dangerous mountain peaks.

Doctor Andrews' party sought the takin in the Tsin-ling

Mountains in the Shensi province of China. When they sighted the first herd, Doctor Andrews described them as "huge, golden-yellow brutes moving on a slope so steep they seemed to be hanging by their horns." To approach the herd the party circled the upper end of a deep gorge. They fought their way through dense thickets of dwarf bamboo. The bamboo stems slashed their faces like whips until they bled. Then rain began to fall, rain as cold as any in the world. They climbed a wall of rock a thousand feet high to the slope where they had seen the herd. When they reached it darkness was falling. The animals had disappeared. The party saw their tents across the gorge, less than half a mile away. But, in the dark, they were unable to reach them, and had to spend the cold wet night on the mountain ledge.

Next morning when they resumed the hunt Doctor Andrews' coat caught on a piece of rock and dragged him over the cliff. As he fell he grasped a bamboo. Fortunately, it bore his weight and saved him from falling headlong down a 300-feet precipice.

When Dr. Andrews' preparations were complete, the Gobi desert expedition left Peking. On April 17, 1922, their cars and lorries climbed a steep pass towards cliff-like hills on whose summit stands the Great Wall of China. Rain and bad roads delayed them. Next day, after dark, all the vehicles were bogged. One by one they dug them out, and camped for the night on a dry patch of ground.

Some days later they reached a place called Tuerin. There they saw a curious mountain. Many thousands of years ago it was an active volcano rising high into the sky. But endless ages of wind and frost have worn it down to the heap of broken granite it is to-day.

Their camel train, carrying additional supplies of fresh petrol, provisions and camp equipment, was waiting for them

Members of the Expedition making Scientific Records among the Rocky Wastes of the Desert.

at Tuerin. They spent some time sorting out these stores. The work was just completed when a terrible desert storm broke upon them. It rent their tents and swept their chairs, tables, and cooking utensils down the hillside in a whirl of sand. The air grew cold. In a few moments the temperature dropped 30 degrees. Although it was the month of May it seemed like winter.

This was not their only storm. In the middle of June, while out in the desert, it began to blow. The wind rose to a gale and a huge bank of cloud swept over the shallow valley where the party searched for fossils.

Doctor Andrews ran down into the valley to recall his men.

The rush of sand and gravel met him. He covered his head with his coat and struggled on until he found a small hollow, where he lay down for protection. Two figures came towards him through the darkness of the sand-filled air—one a white member of the party, and the other a Mongol servant. The Mongol thought their tents lay south from where they were. Trusting to his instinct and clinging together, the three men struggled through the blinding sand in that direction and reached the camp. In their tent they lay down and covered their heads with wet cloths, the only way to breathe safely in the choking atmosphere.

The storm lasted for an hour. It was succeeded by a calm. The last of the party arrived, smothered in sand. The tents were almost buried; for two hours the whole party worked to dig them out. They had scarcely finished when the storm broke once more. It shrieked upon them, carrying a blast of gravel that struck their tents like bullets. Dirty and discouraged, they turned into the shelter of their tents. For ten days the gale beat across the desolate valley where they sheltered.

Scientific work could only be carried out in the Gobi Desert from April to September. During the winter months the weather in that high, cold, bleak land made such work impossible. But their efforts were rewarded by success. They recovered many valuable fossils. Among their finds were 14 skulls of the titanothere, an enormous prehistoric animal, like a big rhinoceros, who existed more than a hundred thousand years ago. The work of preserving these fossils required the greatest care and skill.

Once three large teeth were exposed when digging in the side of a ravine. They fell to powder when they were touched. Mr. Walter Granger—an expert on fossil animal remains—spent four days in digging out this one fossil. He carefully removed the sand with camels' hair brushes, bound up the

The Titanothere, a huge Prehistoric Animal.

fragile bones with gum Arabic and Japanese rice-paper, and finally wrapped each specimen in canvas soaked in flour paste.

By such laborious methods these fossil remains are discovered and preserved. And through these discoveries we can build up a picture of the types of animals who lived in the ages long before history was ever written, strange animals who roamed the shores of the Gobi Sea before it became a desert.

QUESTIONS

1. The Gobi Desert is covered with sand to-day and has been so for centuries. Was it always like this? If your answer is no, indicate what it was like.
2. Plot the Gobi Desert on your map. Measure its length and breadth by the map scale of miles. Take a map of Europe and draw the Gobi Desert upon it to the European map scale. State how many European countries would have to be combined to equal the Gobi Desert in size.
3. During what period of the year can scientific work be carried out in the Gobi Desert? Why cannot it be continued during the remaining months?
4. What is the value of fossil remains such as Doctor Andrews' expedition found in the Gobi Desert?

CHAPTER 8

SHACKLETON'S DISCOVERIES IN ANTARCTICA

ERNEST HENRY SHACKLETON was one of Scott's sledging companions on his first expedition. In the interval between Scott's first and second expeditions Shackleton himself attempted to reach the South Pole. His expedition sailed from England in the *Nimrod* in 1907, and made a base in McMurdo Sound. The aim of his expedition was to reach both the South Pole and the South Magnetic Pole.

The North and South Poles are the ends of the imaginary line about which the earth revolves. The name of this imaginary line is the axis. If you take a small rubber ball and hold it between your thumb and middle finger, with the palm of your hand facing downwards, you will get a good idea of the situation of the North and South Poles. The North Pole is situated where your middle finger presses on the surface of the ball, and the South Pole where your thumb presses. These are the geographic Poles, which are used for the construction of maps.

The magnetic Poles do not lie in the same positions as the geographic Poles. Because a compass needle is a magnet it points to the nearest magnetic Pole. In the northern hemisphere the north end of the compass needle points to the North Magnetic Pole. In the southern hemisphere the south end of the needle points to the South Magnetic Pole. The force that causes the compass needle to point towards the Poles is called magnetic force.

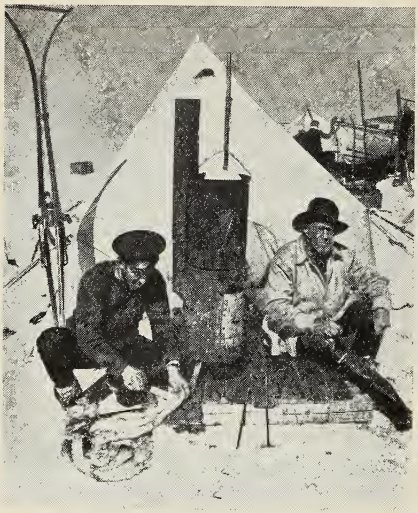
Shackleton's ship *Nimrod* among the snow and ice of the Antarctic.

The North Magnetic Pole is the place where the lines of magnetic force rise from the earth's surface. These lines take an irregular course over the earth's surface. When we plot them on a map we call the lines isogons. The place where the lines enter the earth we call the South Magnetic Pole. The irregularity of the isogons is caused by other centres of magnetic attraction.

Study of the earth's magnetism had engaged research workers for many years, and it was natural for Shackleton to include in the work of his expedition an endeavour to reach the South Magnetic Pole.

Three of Shackleton's party—David, Mawson and Mackay—climbed up the Reeves Glacier and sledged over the Antarctic plateau to the Magnetic Pole. They fixed its position 1,215 miles from the South Pole. On this journey they hauled sledges 1,260 miles in 122 days, and covered 300 miles of ground that had never been explored before.

In the meantime, Shackleton, with Armitage, Marshall,



Shackleton seated outside his Tent.

and Wild, started towards the South Pole on October 28, 1908. Each man led a pony. On November 22 they discovered new land and ice-clad mountains with a gap which gave an almost direct route to the Pole. It rose up a rough, steep glacier with dangerous ice chasms. Three years later Amundsen followed this same route on his successful dash to the South Pole.

On December 7 Shackleton's last pony plunged into a crevasse hundreds of feet deep; its leader, Wild, was fortunate to escape falling with the pony. Next day the party reached a great plateau, 7,400 feet high, surrounded by sandstone cliffs containing coal. On Christmas Day they were 287 miles from the Pole and 9,500 feet above the sea. It was the Antarctic summer. The temperature was 48 degrees below freezing point. Marching south for 157 miles, they reached a height of 10,500 feet on January 6, 1909.

The Pole was only 130 miles away. They had a good prospect of reaching it. But a violent blizzard forced them to remain in their bags for 60 hours. They nearly died of cold in a temperature 70 degrees below freezing point. When the gale broke, their food was running short.

They marched on. Before them stretched the same white plain. Their glasses showed no sign of any change ahead. They decided that the South Pole lay on that immense plateau, between 10,000 and 11,000 feet above the sea. On January 9, within 111½ miles of the Pole, they had to turn back for lack of food.

On the outward journey they had had to reduce their already small rations. When they turned they were hungry and faced with no better prospect for another three months. Their journey was a race with death. When they got back to their base, weak from starvation, they were ill with dysentery. When he returned to England, Shackleton was knighted in recognition of his work.

On July 16, 1914, Queen Alexandra visited Shackleton's next ship, *Endurance*, and presented Shackleton with a flag

The Husky Team before setting out on the Record Trail, showing the snow and ice conditions that were encountered.

and bibles for himself and the crew. On August 1, 1914, the ship sailed from London with 27 men and a stowaway on board. She left South Georgia on December 8, 1914.

Shackleton intended to attempt to cross the continent of Antarctica. Ice-fields in the Weddell Sea prevented a landing on Coats Land. Continuing south, Caird Coast, an extension of Coats Land, was discovered. Following the new coast for about 200 miles, they found typical Antarctic ice-covered land; huge glaciers made landing impossible. Heavy ice forced Shackleton to turn westward towards Graham Land.

On February 15, 1915, the *Endurance* was caught in the ice. She was carried west and north for 700 miles. Then the ice crushed and sank her. The men took to one of the whale boats and with great skill Shackleton landed the whole party on Elephant Island, an ice-capped islet 750 miles from South Georgia. By clever seamanship he reached South Georgia, and, in spite of serious misadventures with the relief ships, the entire party was rescued on August 30, 1916, by the Chilian ship *Yelcho*.

Shackleton left England on his last voyage in the *Quest*. He died on reaching South Georgia on January 5, 1922. His second-in-command, Wild, continued the expedition, but was beset by ice 35 miles from "the appearance of land" reported by Ross in 1843.

QUESTIONS

1. Describe in your own words the difference between the geographic and the magnetic Poles.
2. Which of the Poles did Shackleton's *Nimrod* expedition reach? What discoveries did Shackleton make on this expedition?
3. Trace on the map the new land discovered by Shackleton during the *Endurance* expedition.
4. From the South Polar chart at the back of the book describe in your own words the difference between the routes followed towards the South Pole by (*a*) Shackleton and Amundsen; (*b*) Scott.

CHAPTER 9

TREASURE HUNTING IN THE TOMBS OF THE KINGS OF EGYPT

IN the early days of the Mediterranean civilization, Egypt was the foremost country in the world. The Pharaohs of Egypt ruled over an empire from which they commanded tribute. The word " Pharaoh " is the equivalent of our own word " King."

To-day, men try to learn more of the lives and habits and culture of the people who lived in those ancient days, and seek confirmation of the history contained in the Old Testament of the Bible. We call these students Archæologists.

The excavation of ancient cities is one method of rebuilding the picture of life as it was lived 2,000 and more years ago. This work has been undertaken in many parts of the world—in Iraq, in Palestine, in Egypt, in our own country and elsewhere.

For many years Egypt has been a favourite place for such research. Writings on tablets and on papyrus; carvings, vessels of household use, and ornaments have been discovered. But time and the changes people make for themselves from one period to another always reduce the remains of any civilization. Sometimes, however, special circumstances arose, and care was taken to preserve articles from destruction.

Before the year 1500 B.C. it was the custom to bury the Kings of Egypt in tombs connected with one of the temples; these tombs were readily explored or robbed. About the

year 1500 B.C. King Thothmes I changed this custom, and selected a wild ravine, now known as The Valley of the Tombs of the Kings, for his place of burial.

In time the tombs which were created in the desolate valley were lost. They became most difficult to discover. Yet it was certain that whoever found them would obtain information regarding the life and culture of their period.

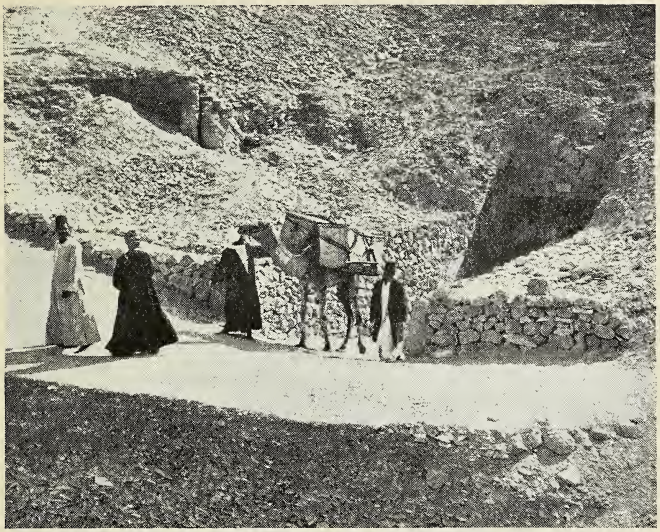
When pharaohs were buried, objects of great value, gold and precious stones, were placed in their tombs. Robbers had worked for thousands of years to recover this treasure for themselves. And so, when a tomb was discovered, there was always the chance that it would be found to have been raided at some earlier date.

Lord Carnarvon became interested in this form of exploration, and in 1906 was allotted a site to work. He knew nothing about excavation, but he gained experience through his early efforts at Thebes.

On his first attempt, before he had been at work 24 hours, Lord Carnarvon suddenly found what he thought was an untouched burial pit. But it was an unfinished and unused pit. The interest his discovery had roused died down, but Lord Carnarvon continued the search. He worked day after day for six weeks, covered in clouds of dust. His total result at the end of that time was the discovery of one mummified cat in its case, which is now in the Cairo Museum.

Undiscouraged, he obtained the services of Mr. Howard Carter, an archæologist with imagination. Together they found something which promised success, but further work showed it was nothing more than a stable, where an ancient Egyptian had kept his donkey and his accounts!

In 1914 another concession was granted to Lord Carnarvon to work in a particular part of the Valley of the Kings. He was told that this place was not worth the labour. But Mr.



The Entrance to the Tomb, in the Valley of the Kings.

Carter thought otherwise. There, about seven years before, an exploration party had found a beautiful blue glaze cup which dated from the time of the pharaoh, Tutankhamen. This discovery was succeeded by the finding of a chamber, cut out of rock at a depth of 25 feet. The chamber was almost full of mud, carried into it by the rains of centuries. In it was found a broken box which contained several pieces of gold, stamped with the names of Tutankhamen and his wife, Ankhsenamen, and a beautiful alabaster statuette.

At first it was thought that this chamber was the king's tomb. But a few days later a pit was found some distance away containing large earthenware pots holding wreaths of leaves and flowers and small bags of powder. Wrapped round

one of the pots was a piece of linen on which writing referring to the sixth year of Tutankhamen's reign was discovered. These things were obviously taken from a tomb. It was then believed that all the articles had been stolen from Tutankhamen's tomb not long after he was buried, and that the rock chamber was a safe in which the robbers hid the valuable goods.

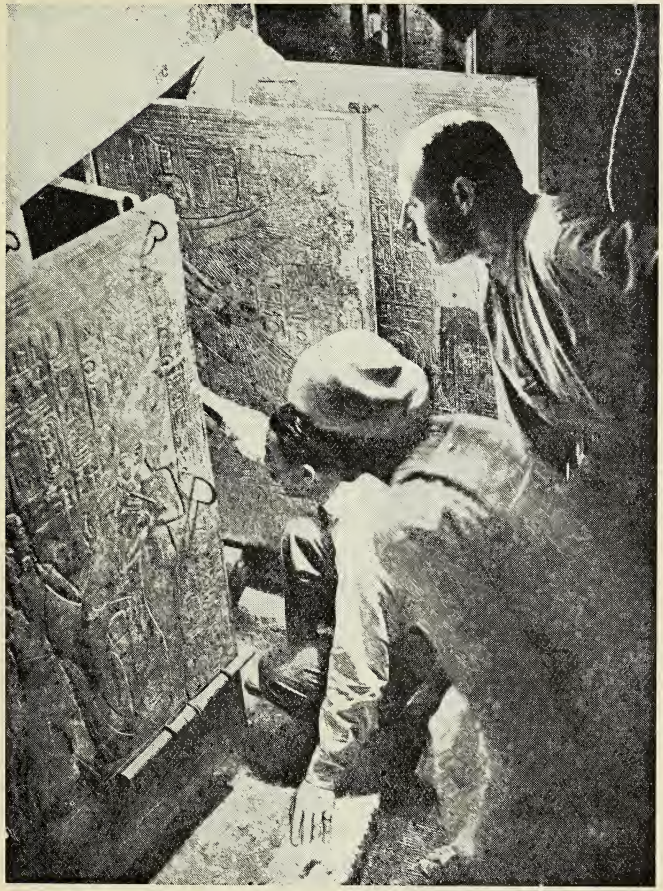
Because of these discoveries, Mr. Carter felt he had a good chance of finding the actual tomb of Tutankhamen. The work went on at intervals for many years. Small articles were found; none was of any importance. In spite of continued disappointments, Mr. Carter remained hopeful of success.

He arrived at the scene of the digging on November 4, 1922, to find an unusual silence; all work had stopped; the workmen had discovered a step. After he had examined the step, they went on removing rubbish. Next day there was sufficient clearance to show a carefully prepared stairway, evidently leading to something.

The hope of success grew more certain as the work continued. Soon they saw the upper part of a solid doorway. When Mr. Carter examined the door he saw that some of the plaster had fallen away at one point, disclosing a heavy wooden lintel. He made a hole, just large enough to enable him to see what lay beyond. The whole place was full of rubble.

The door carried the impressions of a seal, but these did not indicate whose tomb it was. Mr. Carter cabled to Lord Carnarvon, then covered up the tomb so that it could not be seen.

When Lord Carnarvon arrived they began to examine the place more completely. Their examination showed that if the tomb was really that of Tutankhamen it had been broken open and re-closed at least twice some two or three hundred



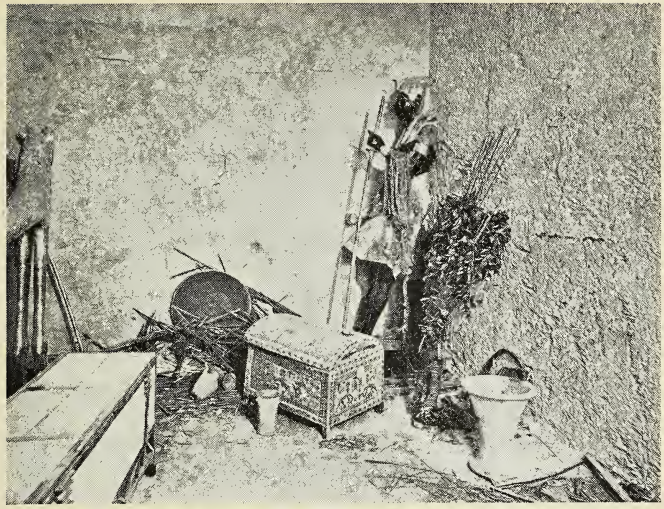
The Opening of the Doors of the Fourth Shrine. The kneeling figure is Mr. Carter.

years after the pharaoh was deposited in it. During the clearance some small articles bearing the names of Ankhsenaten, Tutankhamen and Thothmes III were found.

In the afternoon of November 26 they came to another sealed doorway. The necessary clearing of more rubbish that blocked the lower part of the doorway seemed terribly slow. At last it was done.

With hands trembling with excitement Mr. Carter made a small hole in the upper left-hand corner. He could see nought but darkness. He lit a candle to test the air. If the flame burned, the air was pure. The candle burned. He widened the hole, inserted the candle and peered in. For a time the hot air coming from the chamber caused the flame to flicker. Lord Carnarvon and his daughter, Lady Evelyn, stood anxiously beside Mr. Carter, waiting to know what he saw. When his eyes became used to the dim light, everywhere within the chamber he saw the glint of gold. There were images of strange animals and statues. For a moment he was dumb with amazement. Lord Carnarvon enquired anxiously if he could see anything. Mr. Carter could only reply: "Yes, wonderful things."

Their search was over, but their real work had just begun. When they entered they found no coffin which could contain the body of the king. But they discovered a whole museum-full of objects piled one upon another: all were nearly 3,500 years old. There were life-size figures of the king in black, beautifully painted inlaid caskets, alabaster vases, strange black shrines, bouquets of flowers or leaves, beds, chairs, a golden inlaid throne, a heap of curious eggshaped boxes, a cup of translucent alabaster, chariots glistening with gold and inlay, and a portrait of the king. Every object required careful handling to prevent damage, for not one could ever be replaced.



A view of the Ante-chamber, showing one of the Statues of the King. Part of the unopened sealed doorway is seen at the back.

The room was only an ante-chamber. Between two black sentinel statues they found another sealed door. At one time there had been an opening in the door large enough for a boy or a slim man to creep through. The opening had been filled in and re-sealed. Then they discovered another door with a small unrepaired, ragged hole. Placing a light through this hole they saw a small chamber crowded with objects. The whole of the contents had been ransacked. Everything was in confusion. Boxes were empty; things thrown about lay one on top of another; something covered every part of the floor.

It took weeks to preserve and remove the articles. At last the task was finished. They were ready to penetrate the last secret of the tomb. On Friday, February 17, 1923, Mr. Carter

began to open the solid door. He first made a hole just large enough to insert an electric torch. Less than a yard away he saw something that looked like a solid wall of gold. They worked rapidly to remove the wall. When the last stone was withdrawn they passed into the chamber. The chamber walls were painted with Egyptian scenes. The " wall of gold " was an immense gilt shrine. Great folding doors, closed and bolted, barred the eastern end. They drew the bolts and opened the doors. Before them stood a second shrine.

They entered the presence chamber of the tomb. For the first time in the history of archæology a great shrine under which a pharaoh lay had been disclosed. The object of their search had been attained. They had recovered the body of a king who reigned nearly 3,500 years ago.

The excitement of the find and the work of the search made Lord Carnarvon very tired. After they finished work for the season he was bitten by a mosquito. The bite turned septic, doubtless due to his poor state of health. He lingered for three weeks. Lady Carnarvon, Lady Evelyn, doctors and nurses did all they could to save him. But he died on April 6, 1923, within two months of the successful discovery which he had devoted so many years of his life to achieve.

QUESTIONS

1. Describe in your own words the value of the excavation of ancient burial places.
2. What were the prizes that tempted robbers to raid the tombs of the pharaohs?
3. Mention some of the objects that Lord Carnarvon and Mr. Carter found that could give information regarding the culture of Egypt during the reign of Tutankhamen.
4. The burial place of Tutankhamen was nearly 3,500 years old. From what you know of British history write briefly a comparison of the culture of Egypt with that of the British Isles at the time of Tutankhamen.

CHAPTER 10

MODERN MOUNTAIN EXPLORATION

THERE are parts of the world where people live on high plateaux. In Abyssinia some of the tribes live at 13,000 feet: in Bolivia and in Tibet at over 15,000 feet. But above these heights there are no regular habitations of mankind. The summit of Everest is approximately twice as high.

Mount Everest is the highest mountain in the world. Its huge bulk rises above the general level of the mountain chain of the Himalayas. Its summit is 29,002 feet (equal to $5\frac{1}{2}$ miles) above the level of the sea.

Many difficulties have to be faced in climbing Everest. There is the strain of climbing and traversing the high ground leading up to the base of the actual mountain. Then there is the ascent into regions of the atmosphere far above the highest levels at which human beings, animals or birds live: into an atmosphere where the temperature falls, as it does in the Polar regions: where the air becomes less dense on account of the reduced pressure, and every breath taken carries less air (with its vital oxygen) into the lungs.

Everest climbers must be protected against cold. In the changed atmosphere there is great strain in carrying the extra weight of clothing. On the upper ridges of the mountain it is necessary for climbers to carry bottles of oxygen to make up the deficiency in the atmosphere.

Because of its difficulties as well as its height, Everest has been a beacon calling the mountain explorer to its conquest. Many expeditions have set out to climb it.

Early expeditions had first to discover the easiest and quickest way to climb the lower slopes. On one expedition Mallory, Wheeler and Bullock, through lack of knowledge, followed a particularly difficult route. After months of exposure at a great height they ascended the main Rongbuk glacier, only to find at the end of their climb the north face of Everest towering above them in a series of unclimbable cliffs.

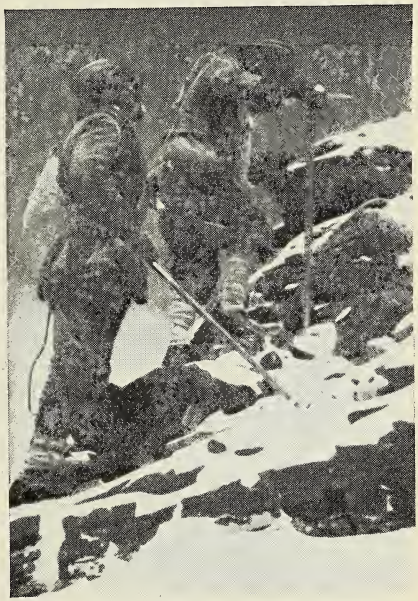
On March 25, 1924, General Bruce led the third Everest expedition from Darjeeling. Oxygen equipment was better and lighter. They were better equipped for transport. The new climbers in the party showed promise of strength and endurance.

On the plains of Tibet, General Bruce went down with fever. Leadership was taken over by Norton, a man of great strength. Beetham, one of the new climbers, became ill with dysentery. Recovering from this, he developed sciatica at the base camp. On the early part of the climb terrible blizzards were met: low temperatures put a tremendous strain on climbers and porters. On one occasion four porters who were marooned on a dangerous spot were rescued by Norton, Mallory and Somervell, at considerable danger to themselves. After erecting six camps up the mountain, the climbing party was forced to retreat to the base camp, where some of the porters refused to attempt to go any higher again.

On June 1, however, Mallory and Bruce led the way up the north ridge in perfect weather. Norton and Somervell, with fresh porters, joined them at Camp 5 next day.

There was a difference of opinion upon the best way to make the final part of the climb. Mallory intended to climb straight to the great north-east arete (the name for a sharp ascending ridge of mountain), follow it to the final pyramid-shaped summit, whence he hoped to be able to climb the two nearly vertical steps which guard the final way.

Norton and Somervell were convinced that the second step was unclimbable. They preferred to travel across the north face, some 300 feet below the north-east arete. They took this route on June 4. Their exertions during May on the glacier below had affected them severely. Somervell had "altitude" throat. This caused his collapse at about 28,000 feet, near the second step. Norton began to suffer from double vision, an indication of coming snow-blindness: brought about partly because he had removed his snow goggles to help him to see exactly where to place his feet, partly by exhaustion and lack of oxygen. They turned back, and when they got down that night they were at the end of their resources.



Mallory and Norton climbing Everest.

Mallory planned one more attempt. Irvine was his companion. They left Norton totally snow-blind. Using oxygen to help them, they reached Camp 5 on June 6 and Camp 6 the following day in perfect weather. The last note sent down by Mallory from Camp 6 said that everything was well. It was the last message received by those who waited below.

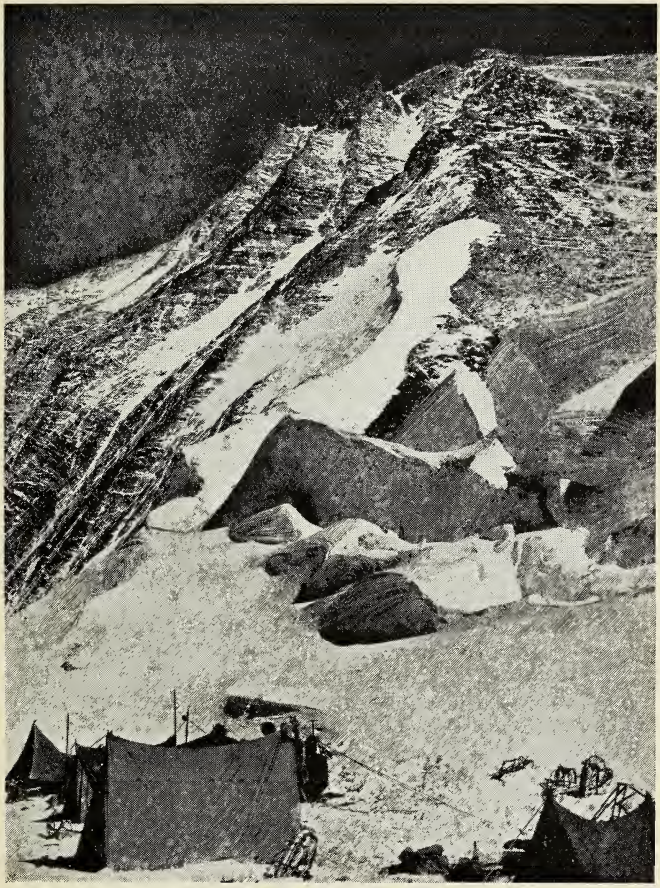
Odell had the task of climbing in support of Mallory and Irvine. Twice he ascended alone to a height of about 27,000 feet. On the first occasion he believed he saw Mallory and Irvine near the second step. Clouds were passing over the north face and the north-east arete, and he could not be certain of their position. The second time he saw nothing. Mallory and Irvine never came back. They had given their lives to the mountain.

Another expedition to conquer Everest left England on January 30, 1933, led by Hugh Ruttledge. The expedition left the Base Camp on April 23 and did not return until June 7. During this time they established eight other camps. The height of the last they estimated at 27,400 feet. This was 600 feet higher than Norton's Camp 6 of 1924, where Mallory and Irvine spent their last night of life, and where Odell climbed in his great effort to find them. Ruttledge's party came across the tent. It looked surprisingly new, but was unusable after nine years of exposure.

A heavy fall of snow prevented the party from reaching the summit of Everest. Ruttledge described their experience inside their tent during this trial in the following words:

> " The wind roared outside, and snow lashed the tent. We listened to tale after tale of bitter, gale-swept ridges; of frozen camps; of desperate ventures along smooth, downward-shelving ledges, where life sometimes depended upon the friction of a single bootnail on the rock; of treacherous snow; of slips corrected only just in time; of upward toil when every nerve in the tired body called for a halt."

Mount Everest has not yet been conquered by climbers. But it has been conquered from the air. Through the skill of designers and engineers, engines have been fitted with super-chargers, which enable them to continue to give their power even in the light atmosphere which exists at great heights.



North Col Camp, and the North-East Shoulder of Everest.

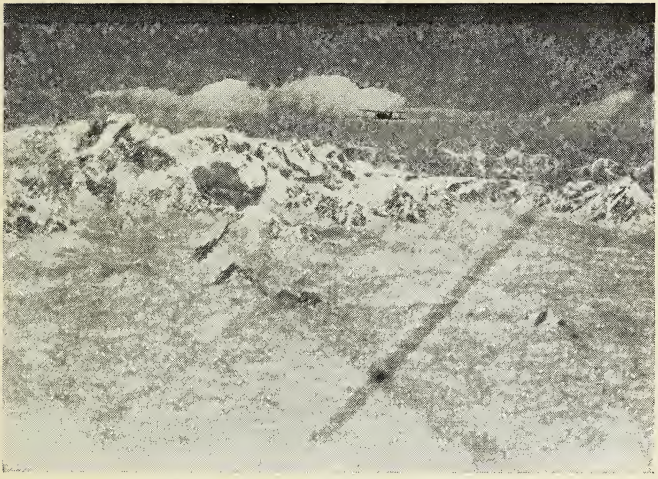
When aeroplanes are fitted with engines of this type they can carry a man high into the upper reaches of the air. By air travel the terrible physical strain of climbing in high altitudes is avoided. The work of months can be reduced to hours through the speed and rapid climb of the aeroplane.

The first expedition to attempt the conquest of Mount Everest by air was called the Houston-Everest Air Expedition. Its object was to collect data of scientific and geographic interest, and to obtain photographs of Everest's summit which hitherto no one had been able to secure. An important feature in the work of the expedition was to be the photographic aerial survey over the highest and most difficult country in the world. The expedition was under the leadership of Air Commodore P. F. M. Fellowes, D.S.O. Squadron Leader the Marquess of Douglas and Clydesdale and Flight Lieutenant D. F. MacIntyre were the pilots. Lieut.-Colonel L. V. S. Blacker was the principal observer, and Mr. S. R. Bonnett and Mr. A. L. Fisher were photographers.

Some of the party flew to India. Others went by sea. Two specially designed Westland aeroplanes with Bristol engines were shipped to Karachi, where they were assembled at the Royal Air Force depôt.

The aeroplanes were flown from Karachi to the main base of the expedition at Purnea. On April 3, 1933, the two Westland aeroplanes left Purnea at 8.25 a.m., piloted by Lord Clydesdale and Flight Lieutenant MacIntyre. Lieut.-Colonel L. V. S. Blacker flew as observer with Lord Clydesdale, and Mr. Bonnett as photographer with Flight Lieutenant MacIntyre. Climbing steadily upward towards Everest, they flew over the summit of the mountain at a height of about 100 feet above it. They took photographs and films throughout the flight and while over the crest of the mountain.

Mr. Bonnett's oxygen pipe became detached while they



One of the Aeroplanes flying over Everest.

were over the summit. Mr. MacIntyre's hand was blistered by the electric glove heater. Fortunately neither mishap had serious consequences.

The aeroplanes landed at Purnea after a three hours' flight, during which they had flown over Everest with ease.

On April 19 they made another flight to the summit. Mr. Bonnett's place was taken by Mr. A. L. Fisher, a cinematographer of the Gaumont-British Film Corporation. From Lord Clydesdale's aeroplane Lieut.-Colonel Blacker took a series of overlapping vertical photographs and a number of oblique photographs to provide a complete survey of the whole strip of country towards the summit of the mountain. Mr. Fisher took films almost continuously. The expedition had then succeeded in its objects, and no further flights were made over Everest.

Thus, through the discovery of the aeroplane and the supercharged engine, Everest, greatest of all mountains, was conquered. From the photographs, it was possible to make a more accurate map of the country in the neighbourhood of Everest, and to show to the world the actual summit of the monarch of mountains which had defied the efforts of the finest foot climbers to conquer it.

QUESTIONS

1. Name three countries where man lives at great heights. What are the natural conditions that prevent regular human habitation at greater heights?
2. By what means do Everest climbers on foot and in the air overcome the natural difficulties of living at great heights?
3. Advance camps are created for Everest foot expeditions just as depôts are placed for Polar expeditions. Describe in your own words any points of similarity between these two forms of exploration.
4. Describe in your own words the advantages of the aeroplane in mountain exploration.

CHAPTER 11

AVIATION CONQUERS THE NORTH POLAR REGIONS

AT the North Pole there is one day and one night each year. During the Polar night—from mid-September to mid-March—the moon appears each month in its first quarter, circles the sky every 24 hours, every day rising higher until it reaches the full; after the full it circles down to disappear beneath the horizon in its last quarter.

Towards the middle of March the sun appears. It travels round the horizon, rising steadily in a spiral. The spiral becomes narrower each day until the middle of June, when the sun starts to return to the horizon about the same spiral path. It sets in mid-September. Because of the continuous light in the summer months (at the South Pole the time of year is reversed), flights in Polar regions are always made during the long Polar day.

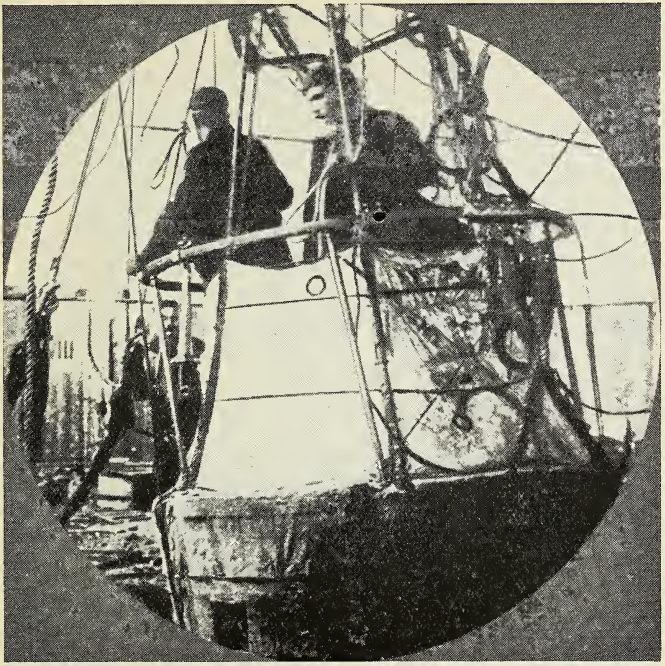
A Swede called Andrée was the pioneer of Polar exploration by air. Before the invention of the aeroplane he set out to travel over the ice-field in an ordinary free balloon. It had no engine and rudder to direct its flight. The basket carried a load of about 5 tons—Andrée and his companions, Strindberg and Fränkel, food, freight and ballast. After leaving Danes Island, Spitzbergen (714 miles from the North Pole), on July 11, 1897, they dropped three message buoys. When these were found, they showed that the balloon had travelled about 200 miles nearer to the Pole.

The balloon was then flying at 820 feet above a rough ice-field, over which the wind was carrying it north-east. After that nothing more was heard of the expedition for thirty-three years. Then the fate of Andrée and his companions was discovered by accident.

On August 6, 1930, a Norwegian exploration party visited White Island, near Franz Josef Land. About 150 yards from the beach the party came across a camp. There were cooking vessels, a boat, and a sledge. The boat contained ice, under which lay the body of Fränkel. A few yards away lay Andrée's body, fully dressed and well preserved by ice. The remains of a polar bear which they had evidently shot lay near them. Strindberg's body was a little further off between some large stones in a cleft in a hill. The boots on the bodies were heavily worn as though by much walking. There was no trace of the balloon. It must have landed elsewhere, whence the three men walked to White Island. In Andrée's pocket was a diary; on one of the last pages was written: " 18/7/1897, 85 degrees North, 32 East." That position was 347 miles from the Pole, so Andrée's party got farther north than their message buoys indicated. The Norwegians erected a cairn on the spot where the camp was found, and carried the bodies to Sweden in their steamer.

In 1923 Amundsen planned to cross the North Polar basin by aeroplane from Alaska to Spitzbergen. To assist him a German expedition was sent to Spitzbergen. This expedition was equipped with a seaplane. When Amundsen's flight proved to be impossible because his machine could not fly the distance non-stop, this seaplane carried out the earliest aeroplane reconnaissances in the Spitzbergen area, and took photographs of the country, which made it possible to map parts of the territory more accurately.

In 1925 Amundsen led an expedition which left King's



Andrée and his Companions in the Gondola of their Balloon.

Bay, Spitzbergen, on May 21, in two flying-boats with a range of 1,200 miles: not far enough to get to the Pole and back. One boat carried Amundsen, Riiser-Larsen, and Feucht; the other Ellsworth, Dietrichson, and Omda: together with food for twenty days.

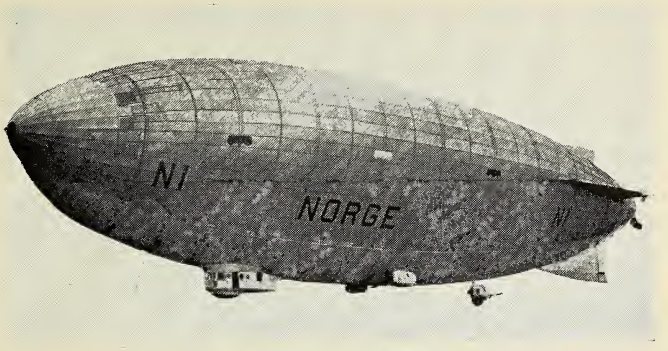
Engine trouble forced them to land in open water in the ice-field 154 miles from the North Pole. After landing, the surface of the water froze. Two soundings of the ocean depth

showed it to be about 12,000 feet. One flying-boat was disabled, and the whole party had to travel in the other. After twenty-five days of continuous and exhausting labour, they succeeded in making a level runway on the ice to enable it to start. On June 15 they rose into the air, and reached Spitzbergen in safety. This was the first successful air reconnaissance of the North Polar basin.

The first men to reach the North Pole by air were Byrd and Bennett. Their flight is described in the next chapter.

Two days after Byrd and Bennett reached the Pole the Italian airship *Norge* left King's Bay, Spitzbergen. Sixteen persons—including Amundsen, Ellsworth, Nobile (the pilot), and Riiser-Larsen—were in the ship when she started at 9.5 on the morning of May 11, 1926. The *Norge* reached the North Pole at 1.25 a.m. next day. No land or water was

Hinlopen Strait, Spitzbergen, photographed from the air.



The Airship *Norge* in Flight.

seen. Two polar bears were the only sign of life observed. At the North Pole the ice was very broken, with piles of small floes. The American, Norwegian, and Italian flags were dropped from the first airship to reach the Pole.

The airship flew on past the Pole and ran into masses of fog. At 8.45 in the morning of May 13 land was sighted: probably Point Barrow, Alaska. The weather was so bad that the airship could not descend until seven o'clock next day, when it landed safely at Teller, Alaska. It is 2,700 miles from King's Bay to Teller, but the distance the airship flew was estimated at 3,300 miles.

In April, 1926, George Wilkins and Carl Eielson left Point Barrow in a single-engined aeroplane and flew north about 140 miles into unknown regions of the Beaufort Sea. No land was seen. Next year they left Point Barrow on March 29 with fuel for 1,400 miles' flying. After travelling north-west 550 miles, engine trouble forced them down. There they took soundings of the sea, and found the ocean some three miles deep. They made temporary repairs and started back. After dark they were forced to land in rough ice. The 'plane was

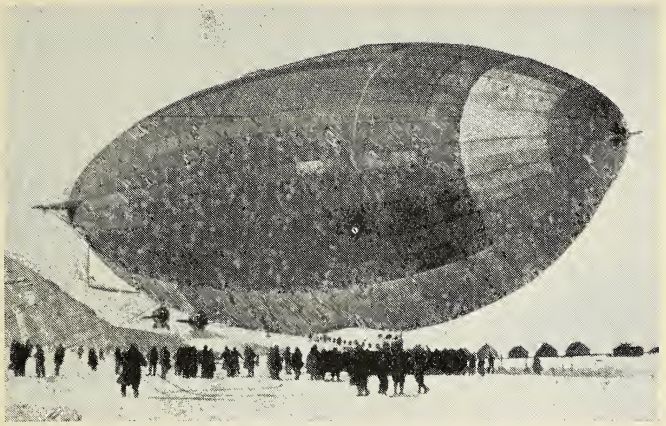
smashed beyond repair. Making sledges from the woodwork of the wreckage, they started for shore. During this journey they saw no land until, after five days' drift on the floes of Beaufort Sea, they reached Eskimo Point. Eielson lost a finger through frost bite. Undeterred, they started from Point Barrow on April 21, 1928, and flew via the north of Grantland and Greenland to Spitzbergen non-stop.

After his flight across the North Pole, Nobile was promoted General and given command of the airship *Italia* for further exploration. Scandinavian, Czecho-Slovakian, and Russian explorers and scientists joined the new expedition. In spite of bad weather, fog, and minor mishaps, the *Italia* flew over Franz Josef Land, and explored part of Lenin Land. Nobile said the latter was larger than had been supposed, and that Gillis Island, disputed among geographers, did not exist.

On the morning of May 23, 1928, the airship started on a flight to the North Pole from its base in King's Bay, Spitzbergen. She reached the Pole twenty minutes after midnight on the 24th. Two hours later the *Italia* wirelessed that she was returning to King's Bay against strong head winds. It was the last message received from the ship. Ice began to collect on the airship; its weight made her heavy. Next morning, when flying at 1,500 feet, she began to lose height. The crew could not check her descent. In less than two minutes she struck the ice. The cabin was torn off and smashed.

The shock knocked several tons of ice from the envelope. Relieved of its weight, and of the weight of the cabin and the engines, the uncontrolled airship bounded back into the air. Carrying six members of the expedition with it, it disappeared to the east and vanished in a great cloud of black smoke.

In the wrecked cabin that lay on the ice, Vincenzo Pomella, the chief mechanic, was so badly injured that he died in a few minutes. Nobile was slightly injured. The engineer, Natale Ceccioni, had a broken leg.



The *Italia* about to start on her tragic Polar Flight.

Five days later, Professor Finn Malmgren, a Swedish meteorologist and explorer, and the Italian Captains Zappi and Mariano left to try to get help. They set out to cross the ice to North-East Island, whence they would attempt to make their way westward to North Cape, where they hoped to get into touch with their supply ship, the *Citta de Milano*. They estimated that the journey of some 90 miles would take 40 days. It was a desperate chance. Malmgren perished on the way. Zappi and Mariano were rescued 43 days later by the Russian ice-breaker, *Krassin*.

Wireless played an important part in the rescue of the remaining survivors. Two weeks after the crash, Guiseppe Biagi, the wireless operator, managed to rig up his apparatus and got a message through to the outside world that some of the members of the expedition were still alive.

On June 20, guided by wireless signals, Major Umberto Maddalena, a famous Italian flyer, found the Nobile camp and

dropped several hundred pounds of supplies. Four days later Lieutenant Einar-Paul Lundborg, a Swedish pilot flying a small two-seater, made a precarious landing. Nobile consented to be the first member of his expedition to be rescued. For this he was greatly criticized, nowhere more than in his own land.

Lundborg set out again from Hinlopen Strait in Spitzbergen and landed to rescue Ceccioni. Re-starting from the rough ice his 'plane crashed; Lundborg was stranded with the remaining members of the Nobile camp—now minus its leader. Eleven days later Lundborg was found and taken off by Lieutenant Schyberg, a pilot of his own squadron.

On July 12, after nearly seven weeks on the ice, the other members of the camp were rescued by a party from the *Krassin*.

One of the aerial rescue expeditions was led by Captain Roald Amundsen. Piloted by Captain René Guilbaud and with a crew of four other Frenchmen, he left Tromsö on June 16 in a French Latham seaplane. Six weeks later the wreckage of the 'plane was found in the Fugloe Islands.

The five courageous Frenchmen lost with Amundsen were the first lives sacrificed in Amundsen's long career in the Arctic and the Antarctic. It was a tragic end to the greatest and most successful career in the history of Polar exploration, during which Amundsen had located the North Magnetic Pole, sailed the North-West Passage, discovered the South Pole and led the first transpolar flight.

QUESTIONS

1. Describe in your own words what you know of the Polar day and the Polar night. Draw a map of the course of the flights mentioned in this chapter, using the map at the end of the book as a guide.
2. Why was the expedition of Andrée a particularly hazardous undertaking?
3. From memory:
   (*a*) Describe the flight of the airship *Norge* over the Polar Sea.
   (*b*) Describe any one of the North Polar flights of Wilkins and Eielson.
4. What was the cause of the disaster to the airship *Italia?* What do you know of the rescues of the crew?

CHAPTER 12

BYRD'S EXPEDITIONS IN THE ARCTIC AND ANTARCTIC

MUCH of the Polar exploration carried out has been the work of Naval officers. Like Admiral Peary, Lieutenant-Commander Richard E. Byrd was an officer of the United States Navy. His work as an explorer brought him renown, and promotion to the rank of Rear-Admiral.

Byrd's first experience of Arctic aviation was with the Macmillan expedition operating from Etah, Greenland, in 1925. Flights carried out in very bad weather, gave him confidence in Polar flying. Next year he and Floyd Bennett set out to reach the North Pole by air. When the expedition arrived at Spitzbergen their aeroplane was taken ashore on a kind of lighter made of planks lashed to boats. A runway was made in the snow for the aeroplane to take off. In the first trial the 'plane ran on to rough ground at the end of the runway. The length of the runway was then increased to nearly a mile, and sprayed with water which froze smooth. The aeroplane rose into the air at 12.30 a.m. on May 9, 1926, and reached the North Pole at 9.4 a.m. the same day.

If you were standing at the North Pole and you turned round and looked in every direction, everywhere you looked would be south, because every line over which you looked would run from the North Pole to the South Pole. When Byrd was approaching the Pole his course was due north; the instant he passed the Pole it became due south; when he turned

round and crossed the Pole to return to Spitzbergen he was again flying south.

Looking down over the waste of ice as they circled the North Pole, Byrd, leader of the second expedition to reach it, saw that the ice conditions were as Peary described them. Thus Peary's story, which had been doubted by some explorers, was confirmed. Because of the rough condition of the ice, Bennett, the pilot, did not attempt to land.

The ordinary magnetic compass is useless in those regions. Byrd, who was the navigator, used an instrument of his own design to enable him to check the course of the flight. It was a sun compass fitted with a rotating hand, like the hour hand of a clock. This hand followed the changing position of the sun, and so enabled Byrd to know the direction in which he was travelling, not by any position on the earth, but in relation to the position of the sun in the sky.

The navigation required for a Polar flight must be exact. Byrd's records, carefully examined after his return to America, proved beyond question that he and Bennett had reached and circled the Pole.

They had a thrilling moment when one hour from the Pole. The right motor began to leak oil. Bennett doubted whether the motor could continue to run. If it failed and they had to land they might crash among the ice ridges. Even if they got down unhurt they would be faced with a tremendous journey back and the possibility of disaster. But they determined to continue their flight to the Pole in spite of this risk. Their decision was the right one. During the return flight the engine ceased to discharge oil. After landing at Spitzbergen at half-past three in the afternoon they found a loose rivet in the tank; when the oil level fell below the rivet the leak ceased.

Had they turned back when the leak began, the *Norge*

Byrd in his giant plane swings away into the unknown reaches of the North Polar Sea.

would have reached the North Pole before them. But courage and determination gave Byrd and Bennett first place in North Pole exploration by air. Bennett died soon after.

Flights over the Arctic showed that the indications of the drift of the wreckage of the *Jeannette* and of the journey of the *Fram* were correct. The North Polar area was a great ice-covered ocean. Byrd thereupon turned his attention to South Polar exploration. Every modern device was employed to make his first survey expedition a success. He had three ships and three aeroplanes. The expedition landed at the Bay of Whales in the Ross Sea at the close of 1928, and was the first to land an aeroplane in Antarctica.

Many flights were undertaken from the main base, called Little America. An area of 40,000 square miles was mapped by air photography. New coastline and a range of mountains, 8,000 to 10,000 feet high, were charted. The new territory discovered was named Marie Byrd Land, after Byrd's wife.

One aeroplane left to form a base in a chain of newly-found mountains named the Rockefeller Range. It was caught in a blizzard of snow and crashed. When the aeroplane failed to return, Byrd with two others left in a second 'plane to search for it. They found the crew of the wrecked 'plane safe and unhurt and brought them back to the main base.

Snow fell heavily and buried the base. Tunnels were cut from hut to hut under the snow, so that no one need be exposed to frost during the four months of total darkness, furious storms, and intense cold. But there was plenty of good food, games of all kinds, and music brought thousands of miles over icy seas by wireless. On August 24 the sun was seen, but the cold was still intense. The two remaining 'planes could not be dug out of their ice-houses until October.

The base was 792 miles from the South Pole. A mountain

Building the Houses that formed Byrd's Base in Little America.

range at least 14,000 feet high rose between. One 'plane left to make an advance base at the foot of Mount Nansen.

Then Byrd and his party waited only for good weather. On November 28, 1929, the geological party, 350 miles south of the main camp, reported by wireless that the weather was as near " set fair " as Antarctic weather ever is. The 'plane started.

As they flew, the crew refilled the tank with petrol and threw away the cans, for, during the climb towards the mountain rampart which guards the South Pole, every pound of weight counted.

Before reaching the crest of the lofty range, the 'plane

refused to climb higher. Something had to be done quickly. Food, equipment, or petrol had to be sacrificed: disposing of petrol might not leave enough to take them back: disposing of food would mean starvation if they were forced to land; Byrd said his men would rather go overboard themselves than lose their precious instruments.

They chose to sacrifice food. A bag went over. The 'plane rose, but not enough to clear the ridge. Another bag went. They jettisoned 300 pounds, enough to keep the four men for six weeks. They all knew that if the 'plane came to grief disaster must follow.

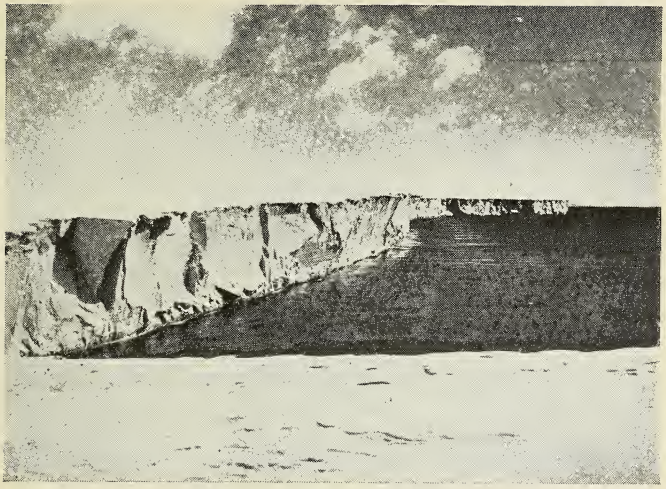
The ridge loomed nearer. They were barely 500 feet above it. As the 'plane flew through the pass with peaks on either side there was dead silence; then all four gave a shout of joy. They were through. No more mountains lay ahead. The level tableland stretched all the way to the Pole.

They flew steadily on. Then Byrd sent a wireless message to the base: " . . . we have reached the vicinity of the South Pole. Flying high for survey."

They opened the trap-door of the cabin and dropped an American flag weighted with a stone from Bennett's grave. They flew the Union Jack above the 'plane in memory of gallant Scott, and circled round, the first men to reach the South Pole by air.

Byrd gave the order to return. Lightened of petrol, and favoured with fair weather, the 'plane recrossed the mountains with ease and made straight for Little America. She arrived there safely, completing the entire journey in 15 hours 51 minutes. What a difference from the weary weeks of struggle of Scott and his companions who explored on foot!

Following his first Antarctic expedition, Byrd planned a second. He wanted to map still more of that desolate continent and wrest more of its secrets from it. Re-opening



The Ross Ice Barrier, Antarctica.

the snow-buried camp of Little America, his expedition of 1934–35 made a special study of the weather conditions in Antarctica; for the weather in the Polar regions affects the weather in other parts of the world. During the Antarctic night, temperatures of the air, speed and direction of the wind, and the barometer reading were taken. Temperatures as low as minus 80° Fahrenheit (112° of frost) were found.

The Ross ice barrier had always been a mystery. No one knew whether it was ice floating on the surface of the sea or grounded on rocks. The expedition found it was anchored on rocks and that it had moved 13·8 miles to the north since Scott surveyed it in 1911.

There is far more life around the area of the North Pole than around the area of the South Pole. Around the North

Pole are found musk ox, polar bear, fox, wolf, arctic hare, reindeer, seal and walrus. The seal is the only one of these animals found in the same area around the South Pole. In Antarctica itself the seal and the Emperor penguin are the only permanent residents. Extensive studies were made of seals. Seals must breathe air to live. Some remained near the ice barrier throughout the long winter, and gnawed the ice freezing on the surface of the water to maintain their breathing holes. During the Antarctic summer, rookeries of the snowy petrel and the skua gull were found.

Ships and aeroplanes of the second Byrd expedition explored unknown seas: aeroplanes, tractors, and sledges explored new land; and proved that Antarctica is one continent, and not two with a strait running between them as had been thought. Sea depth, charted in many new places, proved there is no archipelago in the Pacific Ocean off Antarctica. The Byrd expeditions filled in large areas of the sea charts of Antarctica and of the map of the continent. From them we have learned that the Antarctic region has not always been the same as it is to-day. Ice formerly covered mountain peaks that are now free of ice. At a still earlier period there were volcanoes. Possibly in the distant future Antarctica may become an inhabited continent. If it does, the name of Admiral Richard Byrd will be associated with it in honour of the work he has carried out within its ice-girt coastline.

QUESTIONS

1. Why is aerial navigation difficult in Polar regions?
2. How did Admiral Byrd overcome this difficulty?
3. What risk did Byrd take to reach the South Pole by air?
4. Describe in your own words some of the discoveries made in Antarctica by the Byrd expeditions.

CHAPTER 13

OPENING UP THE REMOTE REGIONS OF TO-DAY

AT the tip of the South American Continent lie numerous islands which end in the notorious Cape Horn. The largest of these islands is called Tierra del Fuego. The words mean " land of fire." It is believed that the name was given to this island by the Magellan expedition which discovered the Magellan Straits at the north end of Tierra del Fuego. They called it " land of fire " because they observed little rising clouds of smoke; they believed the smoke came from the fires of natives, but it was more probably of volcanic origin. Part of Tierra del Fuego belongs to the Argentine and part to Chile. It was not thoroughly explored when in 1928 Gunther Plüschow, a German airman, began to examine it in detail by seaplane.

He had many thrilling flights among the beautiful snow-capped mountains, glaciers, and fjords of that strange land. He took photographs of it and made its appearance known to thousands who had no conception of what it looked like. After completing this expedition he returned to Germany. Setting out again for a second expedition to the same wild land, he reached there safely and began flying once more.

On one of his flights from one lake to another he endeavoured to carry his surplus petrol in tins tied on to the wings of his seaplane. It rose from the water, got up to a height of about 80 feet, but the tins on the wings interfered with the flow of air

and added weight to the machine. It fell and crashed into the water, and Plüschow was killed.

Though a distance of 200 miles does not seem far to us, travel conditions in British Guiana are so bad that it takes three weeks to reach plantations 200 miles up the rivers Essequibo and Mazaruni.

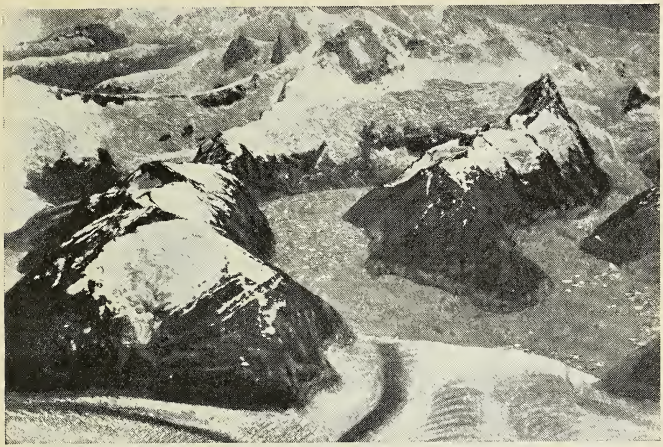
In 1924 a British seaplane started an experimental service up the rivers from George Town, the capital of the country. The seaplane made the journey in a little over two hours, and men, who before had died of black water fever because they could not be brought down to hospital in the capital in time, were transported swiftly by air to George Town and nursed back to health.

This 'plane flew over the wild jungles that line the banks of the river, and Captain G. N. Trace, D.S.C., the pilot who flew it, looked down on country that had never been seen by white men before.

Expeditions to the Amazon country of Brazil have been numerous, but none more successful than those made by air. Great stretches of wild country have been flown over, photographs taken, and more accurate maps made than we possessed before.

A number of savage tribes live in the interior of Brazil, and it is believed that Lieut.-Colonel P. H. Fawcett with his son and a companion, who disappeared in 1925 while exploring the unknown interior on foot, were murdered by one of these tribes.

In the north of Canada the conditions of the country and the severe winters made it impossible for the land to be opened up until the coming of the modern aeroplane brought a means of transport which could operate independently of the ground. New mining sites were opened up and the miners and their supplies transported by air to enable them to work there during



Part of Tierra del Fuego, photographed from the air by Gunther Plüschow.

the summer months. While the miners and prospectors were at work the aeroplanes maintained their supplies of food and tools, and carried their mail; and at the end of the season provided a means of transport for them to return swiftly to the habitable south. By this means new mines have been discovered and opened up.

I myself have flown over the wild tropical jungle of the Sundarbans at the north end of the Bay of Bengal, and looked down on vast stretches of jungle and swamps teeming with wild life, where crocodiles and tigers and pythons abound. I have landed in my seaplane alongside a tiny island, which was little more than a mud flat rising out of the water, on the surface of which trees had found a footing and grew luxuriantly. At the edge of the trees stood two native huts built high above the water on piles to allow for floods and tempests. Only four men

lived on that island, tending herds of buffaloes, which splashed out at low tide knee-deep in mud to crop the grasses which the receding tide left bare.

Native communication in that part of the world is maintained by dug-out canoes, propelled by paddlers at a speed of some four miles an hour. Just think what it means to such parts of the world to have swift communication from the air opening up a new vista of life, and bringing into the humdrum existence of the inhabitants ideas of the modern world which have never been able to penetrate to them in the past.

From my aeroplane I have looked down on stretches of country that have never before been seen; wild and desolate areas where a forced landing would result in disaster. I have passed above mountain ranges, and flown over volcanoes, and seen things from the air which one could see in no other way. In many parts of the world I have found that existing maps were inaccurate. In these remote regions the aeroplane has played and is continuing to play an important part in discovering the true shape of the country, and in assessing the type of vegetation and the possibilities of mineral deposits in areas that can hardly be explored in any other way.

The ancient explorer set out unaware of the perils that confronted him. He sailed across the oceans towards unknown lands, uncertain when he would reach them, without knowledge of the storms and dangers of disease which he might encounter on the way or at his destination. The later explorer, with the world becoming better known, used his skill and knowledge to penetrate further into the detail of human and animal life, of vegetation and mineral wealth, until the important territories of the world became generally known to the civilized races.

The modern explorer is better equipped than the explorers of the early part of the twentieth century. He has far more means at his disposal for his work. He can utilize motor

An aerial photograph taken in Northern Canada. Aeroplane transport has made possible the opening-up of large areas of such country, hitherto undeveloped because of adverse natural conditions.

transport which is capable of traversing almost any type of country. Over snow and ice he can use sledges propelled by airscrews driven by petrol engines. Over sands and swamps he can travel in motor-cars propelled by endless bands in place of wheels. Over mountain ranges and dense jungles, across seas and ice and great lakes, he can pass safely from point to point by aeroplane. From the air he can take photographs which record accurately all that lies below. It is not necessary for him to make notes of what he has seen, notes which may be inaccurate because of the possibility of error in the judgment of human vision. The camera provides a permanent record of everything the explorer sees, and it provides a record in

far greater detail than the human eye and the human memory. The early explorers had no cameras.

Wireless communication has come as a boon and a blessing to explorers. I have known of survey parties buried deep in the heart of the equatorial African jungle, who have been able to listen to the singing of Christmas carols in England while they themselves were encamped under the velvet skies and bright stars of the tropical night, sweltering in heat when the people in England were revelling in the crisp cold of Christmas time.

Modern explorers and discoverers have penetrated the mysteries of the tiny organisms which are so important in the part they play in the life of mankind, have examined large areas of the terrestrial surface of the world, and flown high into the upper reaches of the air to discover the conditions that exist miles above the surface of the earth, in the region of the atmosphere which we call the stratosphere.

The first stratosphere balloon flight was made by Professor Piccard and Monsieur Kipfer on May 27, 1931. They rose from Augsburg, in Bavaria, and were soon lost to the sight of those who watched them from the ground. They climbed into altitudes where the cold was as great as the cold of the Arctic and Antarctic. But in the sealed cabin which was suspended from their balloon they were nearly overcome by heat. The outside of the cabin was painted black; this absorbed most of the direct heat waves from the sun and heated the cabin to a temperature which became almost dangerous for the men inside.

When they were $9\frac{1}{4}$ miles above the earth's surface a valve jammed, and they found themselves suspended helpless in the deep blue of space, while every minute the supply of oxygen which they needed to maintain life was running lower.

When the sun set the fall in temperature reduced the lifting

The Cabin in which the first Stratosphere Balloon Flight was made, photographed after the Balloon landed.

power of the balloon and it began to descend. It fell slowly towards the peaks of the mountains in the Tyrol, and finally came to rest upon a glacier edge, whence Professor Piccard and Monsieur Kipfer were rescued a little later. Both were exhausted by the dangers and fatigues of their adventure.

In August, 1932, Professor Piccard made another ascent with Dr. Max Cosyns, and reached a height of 53,672 feet. As a result of this flight the Professor concluded that certain rays which were believed to originate in outer space were actually produced in the upper belt of the earth's atmosphere.

Another stratosphere exploration expedition started on July 28, 1934, from South Dakota. Major William E. Kepner, Captain Albert W. Stevens, and Captain Orvil A. Anderson

were the crew. The balloon measured 3,000,000 cubic feet capacity. No pains were spared to produce the best possible instruments and equipment for collecting scientific information in this American expedition.

For more than an hour and a half the balloon remained stationary at 40,000 feet to make observations, after which it rose again to nearly 60,000 feet ($11\frac{1}{3}$ miles). The sky above them was black.

At that height a rip appeared in the lower surface of the balloon. It gradually became larger. In three-quarters of an hour the balloon dropped to 40,000 feet, with the speed of descent increasing quickly. Half an hour later it was down to 20,000 feet and falling out of control.

Suddenly, the entire bottom of the balloon fell out. The men in the gondola could see the bare inside of the bag above them. It acted as a parachute. But it was necessary to reduce weight to slow the speed of the fall. They dropped over some of their equipment by parachute. To look after their scientific apparatus the crew stayed in the cabin until the last possible moment.

At 6,000 feet they decided to leave, and one after another the three men dived head first through one of the portholes of the gondola and landed safely with their parachutes.

Russian aeronauts in a stratosphere balloon reached a height of $13\frac{1}{3}$ miles in January, 1934; they sent a sounding balloon with wireless installation and instruments but without passengers to a height of nearly 25 miles during the spring of 1935.

On November 11, 1935, Captain Stevens and Captain Anderson made another stratosphere flight in a new and larger balloon of 3,700,000 cubic feet capacity. The gondola in which they journeyed was a metal ball, 9 feet in diameter; the upper half was painted white and the lower half black.

They reached a height of 14 miles above the earth. It was a cloudless day, but from that height the sky seemed white below them and black around and above them. Numerous scientific observations were made during the flight of 8 hours 15 minutes, which ended with a safe landing 240 miles from the starting point.

There is still much to learn about the atmosphere that surrounds the earth. We know a reasonable amount about the troposphere, the area of the atmosphere that lies nearest to the earth's surface; and about the stratosphere, the next layer above. Soon the stratosphere will be used for fast, long-distance air travel. But there are other layers beyond, about which comparatively little is yet known. There is no doubt that much of the work of the air explorer of the future will lie in higher penetration into the atmosphere above the earth's surface in the endeavour to discover some of the secrets which have baffled scientists; for many things still require a more complete explanation than can be given to them at the present time. When these secrets have been discovered they will help meteorologists to predict the weather, and give to science more

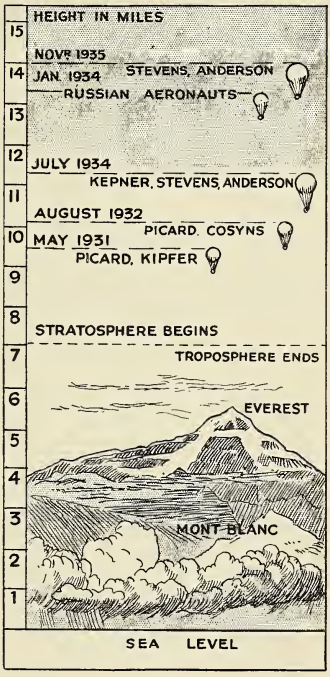


Diagram showing the Great Heights reached in Stratosphere Flights.

knowledge of the differ[illegible] that affect plant and animal life and of the structure of the atmosphere which surrounds the earth like a blanket.

QUESTIONS

1. Draw a map of the Magellan Straits and the outline of Tierra del Fuego. Draw the frontier across Tierra del Fuego and mark to which country each part belongs.

2. George Town is the capital of British Guiana (pronounced Guy-anna). Where is British Guiana situated? What other countries surround it?

3. What useful purpose is served by making balloon flights into the stratosphere?

4. Describe in your own words some of the ways in which modern inventions have helped man to explore and conquer remote parts of the world.

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